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ABSTRACT

This document is an outline of concepts and skills that should be taught at each elementary grade level and for each secondary course in science. This document should be used in planning K-12 science curricula and should serve as a guide for teaching process skills. Separate formats are used for the Elementary Program in Science and the Secondary Program in Science in order that differing needs and time requirements for these grade levels may be met. The elementary level is designed to incorporate both the content and processes of science in order to ensure that students will be prepared for the future. This section is intended to: provide a well-planned, sequential program in the life, earth, and physical science; emphasize hands-on learning; employ clear, well-defined objectives; present knowledge and experiences that students can apply to their lives; and provide useful teacher guidelines for planning and directing science instruction. To assist the teacher, all skills in the program have been coded in relationship to their intended cognitive levels and the specific process skills emphasized. The secondary science curriculum offers the basic courses for the continuation of science as introduced and presented in the elementary grades. Emphasis is placed on the learning of science by involving students with "hands-on" and laboratory exercises. In addition to the standard courses offered in the secondary curriculum, there are course descriptions for studies in a variety of more specialized fields. Courses in the secondary curriculum are designed on a two-semester format. Recommended time allotments are presented in order to ensure uniformity of the curriculum. Four appendices contain information on the following: (1) advanced placement courses; (2) career education in the science education program, instruction in ethics, moral values, and citizenship in science; (3) science for special education; and (4) time requirements for subject areas, and study habits, homework, and students responsibilities. (KR)

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Alabama Course of Study

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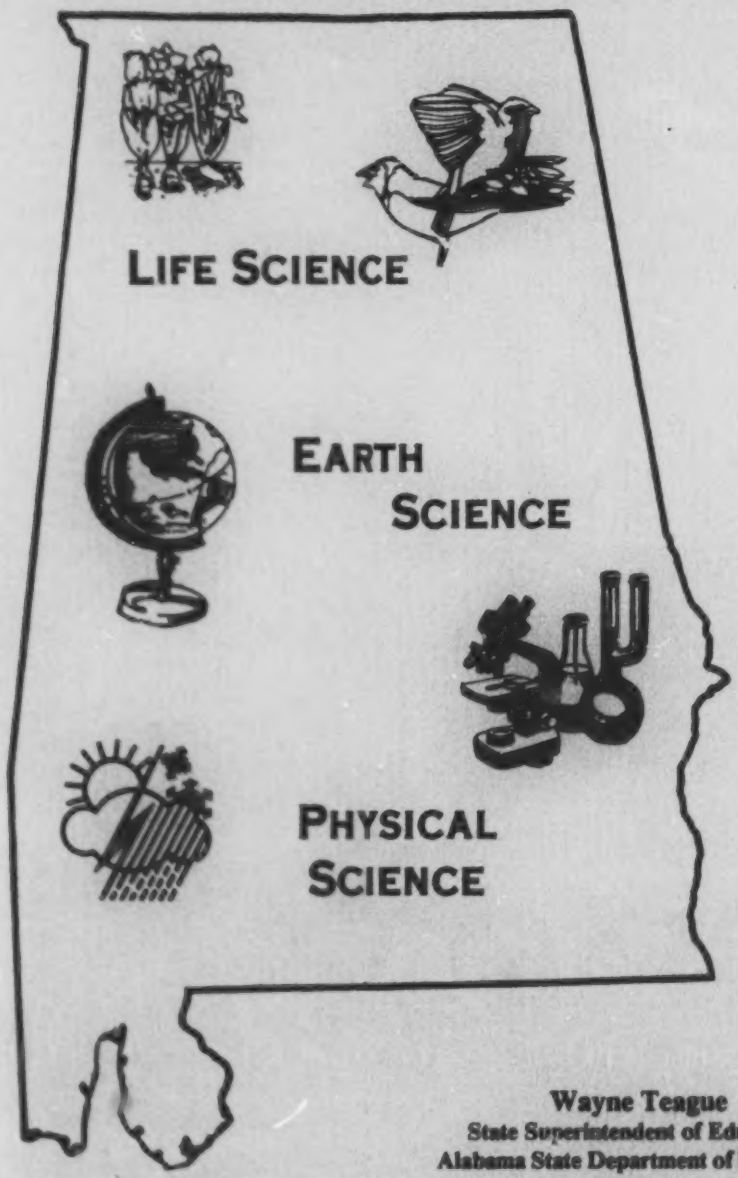

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Alabama State Department of Education

Bulletin 1988, No 35

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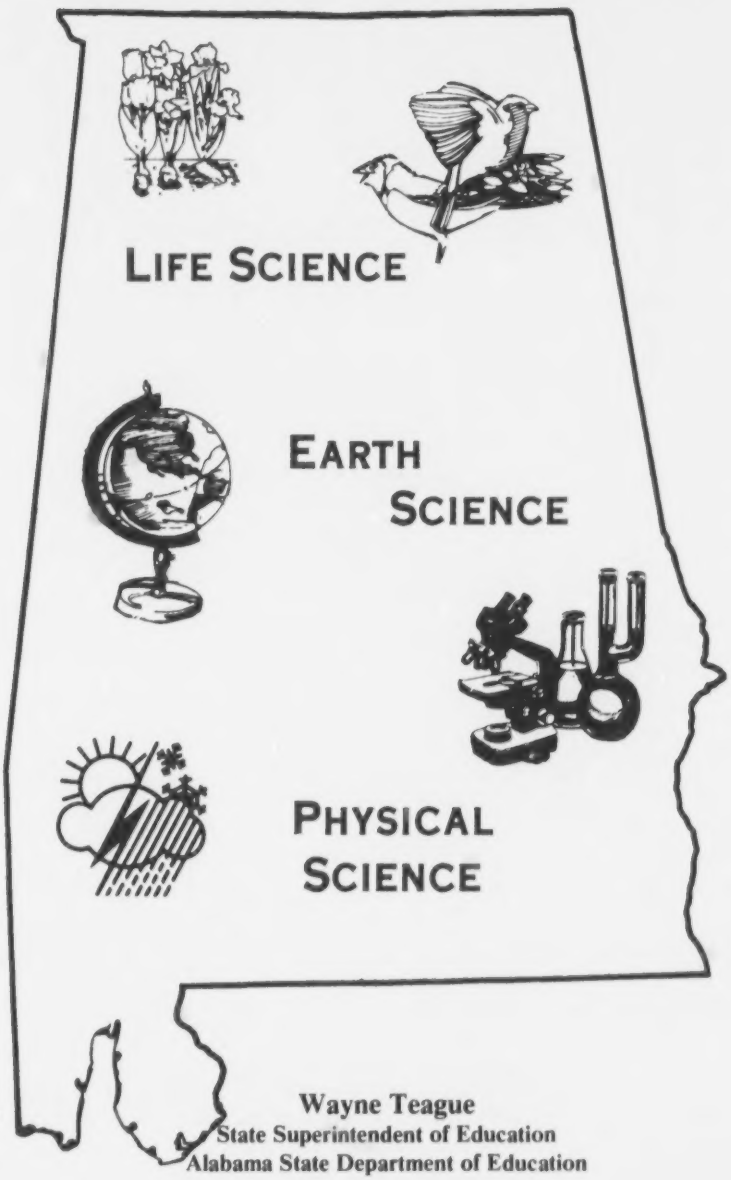

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TABLE OF CONTENTS

		Page
ACKNOWLEDGEMENTS		iii
PREFACE		vii
INTRODUCTION		1
INTRODUCTION TO ELEMENTARY SCIENCE		3
	Kindergarten	13
	First Grade	23
	Second Grade	35
	Third Grade	49
	Fourth Grade	63
	Fifth Grade	79
	Sixth Grade	99
SECONDARY SCIENCE PROGRAM		123
	Seventh Grade Life Science	125
	Eighth Grade Earth and Space Science	133
	Physical Science	143
	Biology	159
	Chemistry	177
	Physics	189
	Additional Courses	203
APPENDIX A	Advanced Placement Courses	217
APPENDIX B	Career Education in the Science Education Program	227
	Instruction in Ethics, Moral Values, and Citizenship in Science	230
APPENDIX C	Science for Special Education Students	233
APPENDIX D	Time Requirements for Subject Areas	241
	Study Habits, Homework, and Student Responsibilities	243

PREFACE

The Alabama Course of Study for Science is an outline of concepts and skills that should be taught at each elementary grade level and for each secondary course in science. This document should be used in planning K-12 science curricula and should serve as a guide for teaching process skills. Teachers are encouraged to use these guidelines as a minimum level of content, and to go beyond these skills and concepts so that all students achieve their maximum potential for learning.

Also included in this publication are advanced placement science courses, additional secondary content areas, and suggestions for teaching science to exceptional students. Laboratory safety guidelines and equipment lists may be found in Science Laboratory Safety Manual for Alabama Schools (Bulletin 1987, No. 71).

The development and use of this course of study is required by law, Code of Alabama, Title 16, Chapter 35, Sections 16-35-1 through 5, and has been approved by the State Board of Education.

INTRODUCTION

The study of science is vital to understanding our world. The accelerated pace of scientific discoveries in the modern world has had tremendous impact on our culture. Never before has there been a greater need for individuals to participate actively in solving problems concerning the environment, technology, population, and countless other areas. The American public looks to education to mold the skills of its students in such a way that they will help contribute solutions for these issues. Knowledge of science concepts and methods of inquiry must be an integral part of each student's educational program if expectations of the public are to be realized. The science curriculum, therefore, should be designed to reflect concerns for today's major issues.

The Alabama Course of Study for Science, Grades K-12, presents a comprehensive science curriculum designed to meet the needs of students and to make them responsible participants in society. Information and activities reoccur throughout the grade levels and courses. Therefore, "sciencing" should be presented using a "spiral technique"; that is, activities and information differing more in sophistication and complexity than in kind. To ensure that continuity prevails, teachers of science should review course content which preceeds and succeeds their own.

Separate formats are used for the Elementary Program in Science and the Secondary Program in Science in order that differing needs and time requirements for these grade levels may be met. No discrimination in format was assigned to the middle school level; however, the unique characteristics of the students at these grade levels should be considered.

Instructional planning should reflect an awareness that these students are moving from concrete to abstract thinking capability and are experiencing brain growth plateaus.

Teachers at all grade levels should utilize a learn-by-doing format which emphasizes process skills. Hands-on activities, demonstrations, laboratories, field trips, projects, papers, fairs, and science olympiads should all be a part of the instructional program. These types of activities foster greater interest in science.

Discovery and exploration are continually adding to the body of knowledge in science. Therefore, some of the content in this document will no doubt become insufficient and obsolete before its next revision. Staying "current in the field" is essential to providing up-to-date information to students. Even more importantly, teachers must recognize that an emphasis on process skills, the "how to" of science, is vital to any science program. A student's repertoire of skills should be many and varied. Critical thinking skills are essential. If equipped with the necessary skills, many of which are taught and refined in the science classroom, students will successfully access the new and developing world of science.

INTRODUCTION TO ELEMENTARY SCIENCE

In a world which is constantly changing, students in school today need an educational background which will prepare them to meet the challenges of the future. To meet these challenges, students need more than an understanding of reading, writing, and mathematics. The basics are not enough. Students today need a sound foundation which will enable them to develop problem-solving and critical thinking skills. At the heart of such development is the science curriculum. Science instruction should and must provide students with the necessary content, processes, and other dimensions of science to ensure successful outcomes for the challenges facing them in the future.

The elementary level of the Alabama Course of Study for Science is designed to incorporate both the content and processes of science in order to ensure that students will be prepared for the future. This section provides a well-planned, sequential program in the life, earth, and physical sciences, emphasizes hands-on learning, employs clear, well-defined objectives, presents knowledge and experiences that students can apply to their lives, now and in the future, and provides useful teacher guidelines for planning and directing science instruction.

To assist the teacher of science, all skills in the program have been coded in relationship to their intended cognitive levels and the specific process skills to be emphasized. For example, the skill "Predict the environments in which different types of plants survive" is labeled 4 and 7. The first number (4) refers to the cognitive level of the skill (**Analysis**) in relationship to Bloom's Taxonomy in the Cognitive Domain. The second number (7) refers to the process skill (**Predicting**). Table 1 on page 4 lists the cognitive skills incorporated into the course of study, while Table 2 on page 5 presents the process skills emphasized.

TABLE 1

LEVELS OF COGNITIVE BEHAVIOR

(1) KNOWLEDGE:	ability to recall; to bring to mind the appropriate material
(2) COMPREHENSION:	ability to comprehend what is being communicated and make use of an idea without relating it to other ideas or material or seeing full meaning
(3) APPLICATION:	ability to use ideas, principles, theories in new, particular, and concentrated situations
(4) ANALYSIS:	ability to break down a communication into constituent parts in order to make organization of the whole clear
(5) SYNTHESIS:	ability to put together parts and elements into a unified organization or whole
(6) EVALUATION:	ability to judge the value of ideas, procedures, methods, using appropriate criteria

TABLE 2

CRITICAL THINKING SCIENCE PROCESSES

(1) OBSERVING: using one or more of the senses to increase one's perceptions in order to learn more about objects and events

(2) CLASSIFYING: simple grouping of objects or events based on common properties to more complex categorizing based on existing relationships between objects or events

(3) INFERRING: proposing of interpretations, explanations, and causes from observed events and collected data

(4) COMMUNICATING: conveying oral or written information verbally as well as visually through graphs, charts, pictures, and diagrams

(5) SPACE/TIME RELATIONSHIPS: estimating the relative positions of moving and nonmoving objects to one another

(6) MEASURING: identifying and ordering of length, area, volume, mass, and temperature to describe and quantify objects or events

(7) PREDICTING: proposing possible results or outcomes of future events based upon observations and inferences drawn from previous events

(8) USING NUMBERS: transfering or application of ordering, counting, adding, subtracting, multiplying, and dividing to quantify data where appropriate in investigations or experiments

(9) INTERPRETING DATA: explaining the meaning of information gathered in scientific situations (activities, field trips)

(10) FORMING HYPOTHESES: making assumptions in order to draw out and test logical consequences

(11) CONTROLLING VARIABLES: recognizing the many factors which affect the outcome of events and understanding their relationship to each other so that one factor (variable) can be manipulated while others are controlled

(12) EXPERIMENTING: testing hypotheses or predictions under conditions where variables are both controlled and manipulated

(13) FORMULATING MODELS: constructing mental, verbal, or physical representations of ideas, objects, or events after which the model is used to clarify explanations or to demonstrate relationships

(14) DEFINING OPERATIONALLY: formulating working definitions which are based upon actual experiences in which the students have participated

Helping students develop a broad understanding of the various skills within the cognitive domain and the utilization of the fourteen process skills is an important component of an effective elementary science program. Another major goal of any good elementary science program, however, should be the development of other skills such as reading, writing, speaking, and listening. All of these skills are necessary for communicating effectively in the elementary science classroom.

TEACHING READING IN THE SCIENCE CLASSROOM

Students in an elementary science program should be taught to:

1. Read for exact meaning.
2. Identify the main ideas expressed in chapter sections.
3. Classify information and organize ideas obtained from reading the text.
4. Note cause and effect relationships.
5. Gain accurate information from visual representations throughout the text.
6. Understand scientific formulas and symbols in the text.
7. Read directions accurately, especially those for carrying out activities and investigations.
8. Locate and use different sources of information.

TEACHING VOCABULARY IN THE SCIENCE CLASSROOM

Teachers of science should help students understand difficult and confusing scientific terms found in the text. Before giving a reading assignment, teachers should:

1. Identify key concepts and vocabulary words in each chapter.
2. Pronounce new words for and with students.
3. Define all new and potentially difficult terms.
4. Draw students' attention to charts, drawings, and photographs that help them understand new words and concepts.

The teaching of specialized reading skills should not be overlooked. These skills, along with the development of writing, speaking, and listening skills, necessary for communicating effectively in the elementary science classroom, help students develop into mature and independent readers both inside and outside of the science classroom. Better readers will develop scientific literacy in a world that is becoming increasingly dependent on science and its technology.

CHARACTERISTICS OF AN EFFECTIVE ELEMENTARY SCIENCE PROGRAM

An effective elementary science program should provide:

1. Hands-on activities selected to promote process skill development of students.
2. Science instruction in life, earth, and physical sciences appropriate for elementary students.
3. Classroom experiences that promote positive attitudes toward science.
4. Use of a variety of instructional strategies and materials.
5. Opportunities for using decision-making and value-analysis skills in solving science-related problems in society.
6. Instruction in selected laboratory, library, and field skills.
7. Periodic evaluation of student learning.
8. Identification and maintenance of high levels of safety in the classroom and other areas used for science instruction.
9. Understanding of the relationship between science, technology, society, and human values.
10. Appreciation for the value of science in the total curriculum and in the personal lives of the students.

The elementary section of this course of study is a blueprint for change in the teaching of science at the elementary level in the State of Alabama. The document calls for utilization of higher level skills in the cognitive domain through the use of process skills. Through the use of this approach to science, students can be expected to develop the skills necessary to insure success in the 1990's and beyond.

SCOPE AND SEQUENCE FOR ELEMENTARY SCIENCE

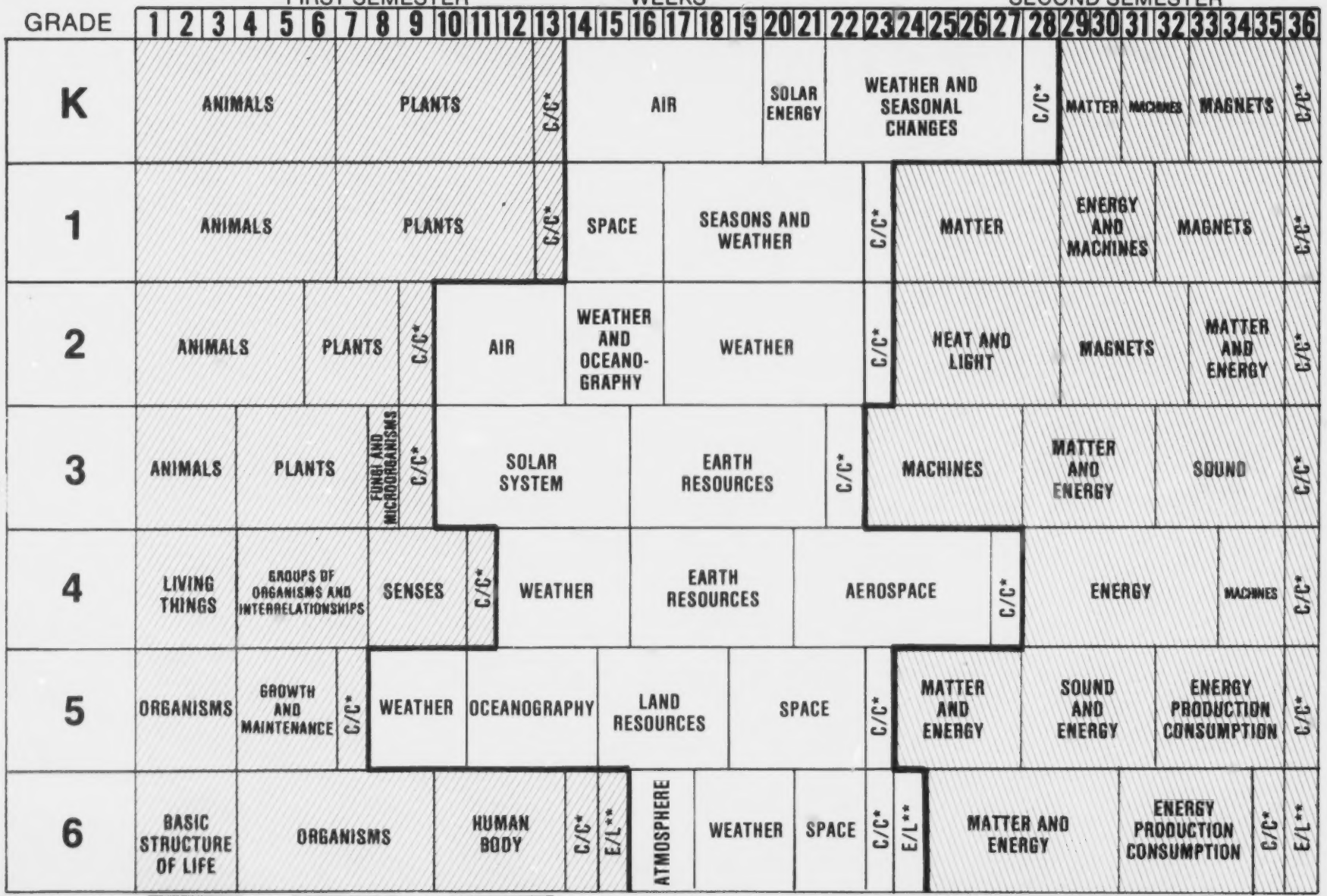
The Scope and Sequence for Elementary Science on page 11 was developed through review of the leading elementary science textbooks, indepth examination of the characteristics, interests, and developmental levels of elementary students, consultations with teachers, administrators, curriculum planners, higher level education personnel, and the general public. It is intended to help teachers, administrators, curriculum planners, and the general public see the specific topics and time to be spent on each scientific concept at each grade level, and also to provide a general overview of the elementary school science program.

The topics presented can be taught in any order at the discretion of the individual teacher or school system, and should be used as a guide to encourage adequate coverage of the numerous scientific concepts at the elementary level. A three week time period has been allocated at each grade level to teach the important contributions of scientists and the career opportunities available in science. Although the "Contributions and Career Sections" are presented at the end of each science discipline, these topics should be presented throughout the school year when the opportunity arises within the individual classroom. Furthermore, in the sixth grade, a new section called "Experimental and Laboratory Skills" has been added. Today's sixth grade students are ready to handle more sophisticated laboratory equipment, experimentation, and to develop abstract thinking skills. It is suggested that the teacher use the sixth grade science program to foster the ability to handle scientific equipment and to develop experimental expertise leading to the development of critical thinking and problem-solving skills.

To do this, teachers must utilize experimentation and laboratory experiences throughout the science program to develop conceptual understanding of the scientific method and to see the need to examine science/technology and societal issues in science.

A more detailed time frame for each major concept, with specific topics for study, can be found at the beginning of each grade level in the course of study. Students who complete the curriculum standards as outlined should achieve well on nationally normed standardized tests and should be academically ready for science instruction at the junior high or middle school levels.

SCOPE AND SEQUENCE



KINDERGARTEN

Children are born explorers. Throughout their early years they should develop their own ways of making sense out of things around them.

In considering an approach for presenting science to kindergarten children, it is important that those who use this publication understand that the following section is but a brief outline of science concepts appropriate for five year old students.

Since most kindergarten students are naturally curious, they possess attributes that are important in the study of science. The everyday experiences of children in their environments should provide an important relevance for them and help them make sense out of their world. The integration of science with other areas of the curriculum should enable children to experience important relationships that are common to everyday occurrences.

KINDERGARTEN

SUGGESTED
TIME FRAME

13 weeks — I. LIFE SCIENCE

(6 weeks) — A. Animals
1. Kinds of animals
2. Helpful and harmful animals
3. Growth and reproduction
4. Movement of animals
5. Adaptations to the environment

(6 weeks) — B. Plants
1. Living and nonliving things
2. Kinds of plants
3. Growth and reproduction
4. Helpful and harmful plants

(3 days) — C. Contributions of Scientists and Science
1. Contributions to the field of Life Science
2. Importance of studying Life Science

(2 days) — D. Careers in Life Science
1. Career awareness
2. Career preparation

15 weeks — II. EARTH SCIENCE

(6 weeks) — A. Air
1. Location of air
2. Uses of air
3. Wind

(2 weeks) — B. Solar Energy
1. Light and heat from sun
2. Uses of solar energy

(6 weeks) — C. Weather and Seasonal Changes
1. Daily weather changes
2. Seasonal weather changes

(3 days) — D. Contributions of Scientists and Science
1. Contributions to the field of Earth Science
2. Importance of studying Earth Science

(2 days) — E. Careers in Earth Science
1. Career awareness
2. Career preparation

KINDERGARTEN

SUGGESTED TIME FRAME		
8 weeks	III.	PHYSICAL SCIENCE
(2 weeks)	A.	Matter 1. Forms of matter 2. Changes in matter
(2 weeks)	B.	Machines 1. Uses of machines 2. Effect on work
(3 weeks)	C.	Magnets 1. Uses of magnets 2. Attraction of magnets
(3 days)	D.	Contributions of Scientists and Science 1. Contributions to the field of Physical Science 2. Importance of studying Physical Science
(2 days)	E.	Careers in Physical Science 1. Career awareness 2. Career preparation

KINDERGARTEN

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
I. LIFE SCIENCE (13 weeks)	Students will	
A. Animals		
1. There are many kinds of animals.	Compare similarities and differences of animals.	Classify animals based on their similarities and differences. *4,2
2. Animals can be both helpful and harmful.	Explain ways animals are useful to people (food, work, protection, and clothing).	Classify animals according to the ways people use them. 4,2
	Explain ways animals are harmful to people.	Communicate harmful effects of animals to people. 2,4
3. Animals grow and reproduce.	Understand that all animals grow and reproduce.	Observe changes in animals as growth takes place. 1,1
		Observe similarities and differences between adult animals and their young. 2,1
	Discuss a variety of foods which different animals eat.	Classify animals based on the type of food eaten. 2,2
4. Animals move in different ways.	Describe similarities and differences in animal locomotion.	Communicate different ways an animal moves. 2,4
5. Environment influences animal life.	Name and describe different animal homes.	Observe different animal homes. 1,1
		Classify a variety of animal homes. 4,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
5. Environment influences animal life. (continued)	Explain how physical characteristics of an animal help to protect it in its own environment.	Infer kinds of animals that would live in a particular habitat. *5,3
	Explain why birds migrate to a warmer environment during winter.	Observe birds migrating. 1,1
B. Plants		
1. Plants are living things.	Discuss difference between living and nonliving things.	Observe living and nonliving things. 1,1
2. There are many kinds of plants.	Name and describe a variety of plants.	Observe plants in the immediate environment. 1,1
		Classify different kinds of plants. 1,2
3. Plants grow and reproduce.	Understand that plants grow in different environments.	Observe different environments in which plant life grows. 1,1
	Identify need for soil, water, and light in proper growth of plants.	Measure growth of plants. 3,6
	Name parts of a plant.	Formulate a model of a plant showing the stem, leaf, flower, and root. 3,13
	Discover that seeds of plants will produce like plants.	Predict type of plant that would grow from a given seed. 4,7

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

KINDERGARTEN

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
4. Plants can be both helpful and harmful.	Explain ways plants are useful to people, (food, clothing, shelter).	Classify plants according to ways people use them. *4,2
	Identify plants that are harmful to people.	Predict harmful effects which some plants have on people. 4,7
C. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Life Sciences.	Identify men and women who have contributed to the field of Life Sciences.	Infer what life would be like without contributions of scientists to the field of Life Sciences. 5,3
	Describe what men and women have done in the field of Life Sciences.	Observe products, inventions, and other findings contributed by men and women in the Life Sciences. 2,1
2. An understanding of Life Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding Life Science to function successfully in society.	Communicate the need for learning Life Science. 2,4
D. Careers in Science		
1. Numerous careers are available for individuals trained in the Life Sciences.	Identify careers related to the understanding of Life Sciences.	Classify careers which are related to understanding of the Life Sciences. 2,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Many careers depend on a basic knowledge of the Life Sciences.	Explain how careers depend upon a basic understanding of Life Sciences.	Communicate ways careers depend on the Life Sciences. *2,4
II. EARTH SCIENCE (15 weeks)		
A. Air		
1. Air is all around us.	Demonstrate and observe that air is all around.	Observe that air is everywhere. 1,1
2. Air is used in many ways.	Demonstrate uses of air.	Communicate many uses of air. 2,4
3. Wind affects objects.	Explain how wind affects objects.	Infer how wind affects objects. 5,3
B. Solar Energy		
1. Light and heat are received from the sun.	Describe effects of light and heat from the sun.	Observe that both light and heat affect objects on earth. 1,2
2. Solar energy is used in homes.	Explain that solar energy can be used to heat homes.	Observe that solar energy heats homes. 1,1
C. Weather & Seasonal Changes		
1. Weather changes each day.	Describe daily weather conditions.	Observe weather conditions. 1,2
	Illustrate different weather conditions through pictures.	Classify different kinds of weather. 4,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Seasonal changes occur in weather.	Identify the four seasons.	Predict seasons by changes in weather conditions. *4,7
D. Contributions of Scientists and Science.		
1. Many men and women have contributed to the field of Earth Sciences.	Identify men and women who have contributed to the field of Earth Sciences.	Infer what life would be like without the contributions of scientists to the field of Earth Sciences. 5,3
2. An understanding of Earth Science is necessary to function in today's and tommorrow's society.	Appreciate the need for an understanding of Earth Science to function successfully in society.	Communicate the need for learning Earth Science. 2,4
E. Careers in Science		
1. Numerous careers are available for individuals trained in Earth Sciences.	Identify careers related to the understanding of Earth Sciences.	Classify careers which are related to the understanding of Earth Sciences. 2,2
2. Many careers depend upon a basic knowledge of Earth Sciences.	Explain how careers depend upon a basic understanding of Earth Sciences.	Communicate ways careers depend on Earth Sciences. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
III. PHYSICAL SCIENCE (8 weeks)	Students will	
A. Matter		
1. Matter is commonly found in three forms.	Identify different forms of matter: solids, liquids, and gases.	Classify matter into its different forms. *4,2
	Identify matter using the five senses.	Observe physical differences of matter: size, shape, color, texture, and odor. 1,1
2. Matter can change form.	Demonstrate matter changes form.	Observe changes in matter. 1,2
B. Machines		
1. Machines are found in everyday school activities.	Describe simple machines used at school.	Observe use of simple machines in everyday school activities. 1,1
2. Machines make work easier.	Discover machines are used to make many kinds of work easier.	Infer why machines make work easier. 5,3
C. Magnets		
1. Magnets are used in different ways.	Demonstrate use of magnets in daily living.	Observe use of magnets. 1,1
2. Magnets attract some kinds of matter.	Demonstrate magnets are attracted to some kinds of matter.	Classify objects which can or cannot be moved by magnets. 4,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

KINDERGARTEN

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
D. Contributions of Scientists and Science	Students will	
1. Many men and women have contributed to the field of Physical Sciences.	Identify men and women who have contributed to the field of Physical Sciences.	Infer what life would be like without the contributions of scientists to the field of Physical Sciences. *5,3
	Describe what men and women have done in the field of Physical Sciences.	Observe products, inventions, and other findings contributed by men and women in the Physical Sciences. 2,1
2. An understanding of Physical Science is necessary to function in today's and tommorrow's society.	Appreciate the need for understanding of Physical Science to function successfully in society.	Communicate need for learning Physical Science. 2,4
E. Careers in Physical Science		
1. Numerous careers are available for individuals trained in the Physical Sciences.	Identify careers related to the understanding of the Physical Sciences.	Classify careers related to the understanding of Physical Science. 2,2
2. Many careers depend on a basic knowledge of the Physical Sciences.	Explain how careers depend on a basic understanding of the Physical Sciences.	Communicate the ways careers depend on the Physical Sciences. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FIRST GRADE

Science for first grade students should be an extension of the kindergarten program. Children are natural scientists. They are continually asking the question, "Why?".

Science must be experienced to be fully understood. Leading educators in child development have established the fact that children invent reality through their mental operations. Therefore, children should be provided chances to interact with objects, ideas, and other children. They develop thinking skills when they explore nature and continually compare their reality with what they observe. For this reason, the first grade science program should be composed of "hands-on" experiences.

The program should be a special part of growing up. It should capitalize on children's natural curiosity and sense of wonder. It should stimulate the imagination and develop logical thinking skills in young children. Finally, it should help six-year-old students develop concepts they will use throughout their lives.

FIRST GRADE

SUGGESTED
TIME FRAME

13 weeks — I. LIFE SCIENCE

(6 weeks) — A. Animals
1. Kinds of animals
2. Growth and reproduction
3. Environmental influence
4. Effects of pollution
5. Use of the senses

(6 weeks) — B. Plants
1. Kinds of plants
2. Growth and reproduction
3. Environmental influence
4. Effects of pollution
5. Interdependence of living things

(3 days) — C. Contributions of Scientists and Science
1. Contributions to the field of Life Science
2. Importance of studying Life Science

(2 days) — D. Careers in Life Science
1. Career awareness
2. Career preparation

10 weeks — II. EARTH SCIENCE

(3 weeks) — A. Space
1. Energy from sun
2. Revolution of the earth
3. Relationship of size to distance

(6 weeks) — B. Seasons and Weather
1. Seasonal changes in weather
2. Adaptation of plants and animals to seasonal changes
3. Weather instruments

(3 days) — C. Contributions of Scientists and Science
1. Contributions to the field of Earth Science
2. Importance of studying Earth Science

SUGGESTED
TIME FRAME

II. EARTH SCIENCE (continued)

(2 days)

D. Careers in Earth Science
   1. Career awareness
   2. Career preparation

13 weeks

III. PHYSICAL SCIENCE

(5 weeks)

A. Matter
   1. Definition
   2. Characteristics
   3. Forms
   4. Changes in matter

(3 weeks)

B. Energy and Machines
   1. Use of energy
   2. Use of machines

(4 weeks)

C. Magnets
   1. Kinds of magnets
   2. Magnetic force

(3 days)

D. Contributions of Scientists and Science
   1. Contributions to the field of Physical Science
   2. Importance of studying Physical Science

(2 days)

E. Careers in Physical Science
   1. Career awareness
   2. Career preparation

FIRST GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
I. LIFE SCIENCE (13 weeks)	Students will	
A. Animals		
1. Animals can be grouped according to their characteristics.	Identify different kinds of animals.	Observe characteristics of living matter. *1,1
		Classify animals into groups based on their characteristics. 4,2
2. Animals grow and reproduce.	Understand that all animals grow and reproduce.	Observe changes which occur as growth takes place. 1,1
		Classify similarities and differences between parents and their young. 1,2
		Measure weights and heights of animals. 3,6
	Explain that all animals need food for growth.	Predict what would happen to an animal with an improper diet. 4,7
3. Environment influences animal life.	Describe characteristics of an animal's habitat.	Observe homes of different animals. 1,1
		Classify a variety of animal homes. 4,2
4. Pollution affects animal life.	Explain harmful effects of pollution on animals.	Communicate harmful effects of pollution. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
4. Pollution affects animal life. (continued)		Predict results of pollution on animals. *4,7
5. Sense organs are useful to animals.	Discover that sense organs help animals.	Observe function of each of the five senses. 1,1
		Predict what life would be like without the five senses. 4,7
B. Plants		
1. Plants can be grouped according to their characteristics.	Classify different kinds of plants.	Observe different kinds of plants. 1,1
		Classify plants in the immediate environment. 1,2
		Classify plants as to size, color, shape, and texture. 2,2
2. Plants grow and reproduce.	Understand that plants grow and reproduce.	Observe plants which reproduce their own kind. 1,1
		Formulate a model of a plant showing the roots, stem, leaf, and flower. 3,13
	Understand need for sun, water, soil, and air for proper growth.	Measure growth of plants. 3,6

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FIRST GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
3. Environment influences plant life.	Describe different places where plants grow.	Observe plant life in different locations. *1,1
4. Pollution affects plant life.	Explain harmful effects of pollution on plants.	Communicate harmful effects of pollution on plants. 2,4
5. Plants and animals are dependent upon each other.	Explain how plants and animals depend on each other.	Infer how plants and animals depend on each other. 5,3
C. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Life Sciences.	Identify men and women who have contributed to the field of Life Sciences.	Infer what life would be like without contributions of scientists to the field of Life Sciences. 5,3
	Describe what men and women have done in the field of Life Sciences.	Observe products, inventions, and other findings contributed by men and women in the Life Sciences. 2,1
2. An understanding of Life Science is necessary to function in today's and tomorrow's society.	Appreciate the need for an understanding of Life Science to function successfully in society.	Communicate the need for learning Life Science. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
D. Careers in Science		
1. Numerous careers are available for individuals trained in the Life Sciences.	Identify careers related to understanding of the Life Sciences.	Classify careers which are related to understanding of the Life Sciences. *2,2
2. Many careers depend on a basic knowledge of the Life Sciences.	Explain how careers depend on a basic understanding of the Life Sciences.	Communicate ways careers depend on the Life Sciences. 2,4
II. EARTH SCIENCE (10 weeks)		
A. Space		
1. Energy is received from the sun.	Explain that heat and light come from the sun.	Observe that light and energy come from the sun. 1,1 Measure amount of heat from the sun. 3,6 Infer that sun warms the earth. 5,3
2. The earth revolves around the sun.	Demonstrate that the earth moves around the sun.	Recognize and use spatial relationships to demonstrate the earth-sun system. 4,5
3. Large objects appear small at a distance.	Observe that larger objects appear smaller when viewed from a distance.	Use spatial relationships to compare size of large objects at close range and at a distance. 4,5

*The first number refers to the Cognitive Level, the second the Process Skill being emphasized.

FIRST GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
B. Seasons and Weather	Students will	
1. Seasonal changes occur in weather.	Describe changes in weather during spring, summer, autumn, and winter.	Predict seasons by changes in weather conditions. *4,7
		Infer types of clothing necessary in each of the four seasons. 5,3
2. Plants and animals adapt to seasonal changes.	Describe changes in plants and animals as seasons change.	Observe how animals prepare for different seasons. 1,1
	Describe severe weather which occurs in the different seasons.	Communicate the safety precautions to be used in severe weather. 2,4
3. Scientists use instruments to collect weather information.	Describe various instruments scientists use to collect data about weather.	Observe various types of instruments used by weather forecasters. 1,1
C. Contributions of Scientists and Science.		
1. Many men and women have contributed to the field of Earth Sciences.	Identify men and women who have contributed to the field of Earth Sciences.	Infer what life would be like without contributions of scientists to the field of Earth Sciences. 5,3
	Describe what men and women have done in the field of Earth Sciences.	Observe products, inventions, and other findings contributed by men and women in the Earth Sciences. 2,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. An understanding of Earth Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Earth Science to function successfully in society.	Communicate the need for learning Earth Science. *2,4
D. Careers in Science		
1. Numerous careers are available for individuals trained in the Earth Sciences.	Identify careers related to understanding of the Earth Sciences.	Classify careers which are related to understanding of the Earth Sciences. 2,2
2. Many careers depend on a basic knowledge of the Earth Sciences.	Explain how careers depend on a basic understanding of the Earth Sciences.	Communicate ways careers depend on the Earth Sciences. 2,4
III. PHYSICAL SCIENCE (13 weeks)		
A. Matter		
1. All material found on earth is composed of matter.	Identify different kinds of matter.	Classify kinds of material as matter. 4,2
2. All matter occupies space.	Observe that matter takes up space.	Observe that visible or invisible matter occupies space. 1,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FIRST GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
3. Matter can be grouped according to certain characteristics.	Identify characteristics of matter.	Classify matter as to size, shape, color, weight, texture, odor, and temperature. *4,2
4. Matter is commonly found in three forms.	Explain different forms of matter: solids, liquids, and gases.	Classify matter into different forms. 4,2
5. Matter can change form.	Explain changes which can occur in matter.	Observe changes that occur in matter. 1,1
	Demonstrate that heat causes water to evaporate.	Observe that heat changes ice to water. 1,1
		Predict what will happen when heat is applied to a liquid. 4,7
B. Energy and Machines		
1. Energy is required to move things.	Demonstrate that energy is needed to move things.	Observe that force is needed to make things move. 1,1
2. Machines make work easier.	Discover machines are used to make many kinds of work easier.	Observe that wheels make work easier. 1,1
		Infer why machines make work easier. 5,3
C. Magnets		
1. There are different kinds of magnets.	Identify different kinds of magnets: round, horseshoe, bar, and natural.	Classify kinds of magnets. 4,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FIRST GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Magnetic force differs within magnets.	Explain that magnets have various levels of magnetic force.	Classify objects which can or cannot be moved by magnets. *4,2 Experiment with magnets to find various strengths of magnetic forces. 4,2
D. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Physical Science.	Identify men and women who have contributed to the field of Physical Science. Describe what men and women have done in the field of Physical Science.	Infer what life would be like without contributions of scientists to the field of Physical Science. 5,3 Observe products, inventions, and other findings contributed by men and women in the Physical Sciences. 2,1
2. An understanding of Physical Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Physical Science to function successfully in society.	Communicate the need for learning Physical Science. 2,4
E. Careers in Science		
1. Numerous careers are available for individuals trained in the Physical Sciences.	Identify careers related to understanding of the Physical Sciences.	Classify careers which are related to understanding of the Physical Sciences. 2,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FIRST GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Many careers depend on a basic knowledge of the Physical Sciences.	Explain how careers depend on a basic understanding of the Physical Sciences.	Communicate ways careers depend on the Physical Sciences. *2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

SECOND GRADE

An elementary science program should play a major role in helping today's children grow up with the thinking skills they need for making intelligent decisions and solving problems now and in the future. The second grade science curriculum is a solid, well-balanced foundation of science concepts based on three major blocks: Life Science, Earth Science, and Physical Science. Coverage of topics includes animals, plants, air, water and oceanography, weather, heat and light, magnets, matter and energy, contributions of scientists and science, and careers in science.

Students at differing levels of ability should be given opportunities to learn basic science concepts. Science vocabulary should be introduced and developed in a way that makes learning easier. Activities utilizing hands-on experiences ensure the use of process skills by the students. Science concepts should capitalize on children's abilities to gather, understand, apply, and evaluate information presented in science textbooks, during field trips, and through scientific investigations.

Objectives and processes should provide skill-building experiences that will teach children how to arrive at concepts when presented with new situations. In this manner, they will develop an understanding of concepts which can be used for a lifetime.

SECOND GRADE

SUGGESTED
TIME FRAME

9 weeks — I. LIFE SCIENCE

(5 weeks) — A. Animals
1. Kinds of animals
2. Adaptation to their environments
3. Interdependence of plants and animals
4. Endangered or extinct species
5. Life cycles

(3 weeks) — B. Plants
1. Kinds of plants
2. Adaptation to their environments

(3 days) — C. Contributions of Scientists and Science
1. Contributions to the field of Life Science
2. Importance of studying Life Science

(2 days) — D. Careers in Life Science
1. Career awareness
2. Career preparation

14 Weeks — II. EARTH SCIENCE

(4 weeks) — A. Air
1. Properties of air
2. Location of air
3. Air pressure
4. Uses of air
5. Need for air
6. Pollution of air

(3 weeks) — B. Water and Oceanography
1. Surface of earth
2. Characteristics and properties of water
3. Uses of water
4. Importance of water
5. Pollution of water

(6 weeks) — C. Weather
1. Changing conditions
2. Use of instruments
3. Forecasting weather conditions
4. Effects of seasonal changes on plants and animals
5. Relationship between altitude and temperature

SUGGESTED
TIME FRAME

II. EARTH SPACE SCIENCE (continued)

(3 days)

D. Contributions of Scientists and Science
   1. Contributions to the field of Earth Science
   2. Importance of studying Earth Science

(2 days)

E. Careers in Earth Science
   1. Career awareness
   2. Career preparation

13 weeks

III. PHYSICAL SCIENCE

(5 weeks)

A. Heat and Light
   1. Reflection and absorption of light
   2. Sources of heat and light
   3. Materials which transmit light
   4. Applications of heat energy
   5. Values and dangers of fire

(4 weeks)

B. Magnets
   1. Kinds of magnets
   2. Magnetic force
   3. Construction of magnets
   4. Uses of magnets

(3 weeks)

C. Matter and Energy
   1. Changing chemical energy
   2. Principle of displacement
   3. Predicting outcomes of experiments

(3 days)

D. Contributions of Scientists and Science
   1. Contributions to the field of Physical Science
   2. Importance of studying Physical Science

(2 days)

E. Careers in Physical Science
   1. Career awareness
   2. Career preparation

SECOND GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
I. LIFE SCIENCE (9 weeks)	Students will	
A. Animals		
1. There are many kinds of animals.	Describe a variety of animals and compare them for similarities and differences.	Classify animals based on their similarities and differences. *4,2
2. Animals adapt to their environments.	Observe and describe characteristics of animals in various environments.	Observe characteristics of animals that live in certain environments. 1,1
		Infer type of animal which might survive in a given habitat. 5,3
3. Plants and animals are interdependent.	Explore interdependence of animals and plants.	Observe animals and plants that depend upon each other. 1,1
	Discuss characteristics of a food web.	Formulate a model of a food web. 3,13
4. Some animals are endangered or extinct.	Identify animals which have become endangered or extinct.	Classify animals which are extinct, endangered, or not endangered. 4,2
		Communicate methods to prevent animals from becoming extinct. 5,4
5. Animals exhibit different life cycles.	Explore life cycles of some animals.	Observe life cycles of some animals. 1,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
B. Plants	Students will	
1. There are many kinds of plants.	Describe a variety of plants and compare them for similarities and differences.	Classify plants in their respective groups based on similarities and differences. *4,2
	Measure, record, and predict growth of plants.	Observe growth of plants. 1,1
2. Plants adapt to their environments.	Observe and describe characteristics of plants that live in certain environments.	Infer the types of plants which might survive in certain environments. 5,3
	Draw conclusions about the types of plants which might survive in a given environment.	Predict environments in which different types of plants survive. 4,7
	Construct a terrarium to represent different habitats.	Observe different habitats in a terrarium. 1,1
C. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Life Sciences.	Identify men and women who have contributed to the field of Life Sciences.	Infer what life would be like without contributions of scientists to the field of Life Sciences. 5,3
	Describe what men and women have done in the field of Life Sciences.	Observe products, inventions, and other findings contributed by men and women in the Life Sciences. 2,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. An understanding of Life Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Life Science to function successfully in society.	Communicate the need for learning in the Life Sciences. *2,4
D. Careers in Science		
1. Numerous careers are available for individuals trained in the Life Sciences.	Identify careers related to understanding of the Life Sciences.	Predict which careers depend on an understanding of the Life Sciences. 4,7
2. Many careers depend on a basic knowledge of the Life Sciences.	Explain how careers depend on a basic understanding of the Life Sciences.	Communicate how and in what ways careers depend on the Life Sciences. 2,4
II. EARTH SCIENCE (14 weeks)		
A. Air		
1. Air has unique characteristics (properties).	Use the senses and describe characteristics of air.	Communicate how the senses can be used in describing characteristics of air. 2,4
2. Air can be found all around us.	Discover that air is everywhere.	Infer what life would be like without air. 4,3
3. Air has pressure and can also be compressed.	Observe and describe that air pushes in all directions.	Experiment to show how air pushes in all directions. 3,12

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

SECOND GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
3. Air has pressure and can also be compressed. (continued)	Demonstrate how air can be compressed.	Infer that air can be compressed. *5,3
4. Air has many uses.	Observe ways air can make work easier.	Communicate that air can make work easier. 2,4
5. Air is essential for life.	Discover that living things need air to survive.	Infer that living things need air to survive. 5,3
	Learn different ways by which living things obtain and use air: lungs, moist skin, gills or spiracles.	Observe different ways by which living things obtain and use air. 2,1
6. Polluted air can damage living as well as non-living things.	Identify causes and control of air pollution.	Communicate need for control of air pollution. 2,4
		Infer causes and provide examples of air pollution. 5,3
B. Water and Oceanography		
1. Three-fourths of the Earth's surface is covered with water.	Understand that much of Earth's surface is covered by water.	Formulate a model demonstrating water and land areas of the earth. 3,13
2. Water has distinctive characteristics (properties).	Compare pond and distilled water.	Interpret data on the basis of biotic and abiotic components of pond and distilled water. 4,9

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

SECOND GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Water has distinctive characteristics (properties). (continued)	Demonstrate that water takes up space and has weight.	Experiment with water, demonstrating that water takes up space and has weight. *3,12
	Observe water can exist in any one of three states.	Experiment with water to discover its three states. 3,12
	Demonstrate and observe that moving water has force and can do work.	Predict what will happen as moving water creates force. 4,7
3. Water is used for recreation.	Describe uses of water for recreational activities.	Communicate uses of water for recreational activities. 2,4
4. Water is important for living things.	Observe, describe, and explain importance of the water cycle to living things.	Infer importance of the water cycle to living things. 5,3
	Discover all living things need water to survive.	Infer what would happen if living things were deprived of water. 5,3
5. Polluted water can damage living as well as nonliving things.	Discover that polluted water contains impurities which damage living as well as nonliving things.	Predict impact of polluted water on living and nonliving things. 4,7
	Explore causes of water pollution and draw conclusions about preventive methods.	Communicate ways to prevent water pollution. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

SECOND GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
C. Weather	Students will	
1. Weather conditions change daily.	Observe that weather conditions change daily.	Observe different weather conditions. *1,1
2. Instruments can be used to measure weather conditions.	Use weather instruments to measure weather conditions.	Use numbers from weather instruments to collect information about the weather. 3,8
	Record data about weather over a period of several days.	Interpret data on temperature change. 4,9
3. Observation is an important part of predicting weather.	Listen to weather forecasts on the radio or television.	Predict weather conditions based on observation of weather forecasts. 4,7
4. Seasonal changes affect plants and animals.	Examine how plants and animals are affected by seasonal changes.	Communicate effects of seasonal changes on plants and animals. 2,4
5. There is a relationship between altitude and temperature.	Predict coming weather conditions from weather forecasts.	Observe and compare weather patterns with local weather forecasts. 4,1
D. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Earth Sciences.	Identify men and women who have contributed to the field of Earth Sciences.	Infer what life might be like without contributions of scientists in the field of Earth Sciences. 5,3

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

SECOND GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
1. Many men and women have contributed to the field of Earth Sciences. (continued)	Identify what men and women have done in the field of Earth Sciences.	Observe products, inventions, and other findings contributed by men and women in the Earth Sciences. *5,3
2. An understanding of Earth Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Earth Science to function successfully in society.	Communicate the need for learning in the Earth Sciences. 2,4
E. Careers in Science		
1. Numerous careers are available for individuals trained in the Earth Sciences.	Identify careers related to understanding of the Earth Sciences.	Predict which careers depend on understanding of the Earth Sciences. 4,7
2. Many careers depend on a basic knowledge of the Earth Sciences.	Explain how careers depend on a basic understanding of the Earth Sciences.	Communicate how and in what ways careers depend on the Earth Sciences. 2,4
III. PHYSICAL SCIENCE (13 weeks)		
A. Heat and Light		
1. Heat and light can be reflected and absorbed.	Observe that light and heat can be reflected or absorbed.	Experiment to demonstrate light and heat can be reflected or absorbed. 3,12

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Student will	
2. There are various sources of heat and light.	Identify possible sources of heat and light.	Observe and describe possible sources of heat and light. *2,1
	Explain that the earth receives heat and light from the sun.	Observe that the earth receives heat and light from the sun. 2,1
	Identify sources of natural and man-made light.	Classify manmade and natural sources of light. 4,2
3. Some materials transmit light.	Classify objects according to ways they transmit light.	Classify objects as transparent, translucent, or opaque. 4,2
4. Heat energy has many useful applications.	Demonstrate useful applications of heat energy.	Infer that heat energy is used to meet many needs of living things. 5,3
5. Fire is valuable but dangerous if not controlled.	Describe how fire is useful, how it is dangerous, and safety precautions to be followed in case of fire.	Communicate safety precautions to use if trapped by a fire. 2,4
B. Magnets		
1. There are many kinds of magnets.	Identify kinds of magnets: horseshoe, bar, circular, and natural.	Classify kinds of magnets. 4,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. A magnet has force.	Describe things a magnet can move.	Observe materials a magnet can pull through. *2,1
	Observe that a magnet is strongest at its poles.	Infer places on a magnet where its pull is strongest. 5,3
3. Magnetic properties can be transferred to some nonmagnetic materials.	Demonstrate how some nonmagnetic materials can become a magnet.	Observe construction of magnets. 2,1
4. Magnets have many uses.	Discover that a compass is a magnet which can be used to find directions.	Observe how magnets can be used to make compasses. 2,1
C. Matter and Energy		
1. Chemical energy can be changed into mechanical energy.	Identify an example of chemical energy being changed into mechanical energy.	Observe chemical energy being changed into mechanical energy. 2,1
2. Objects sink or float due to the displacement of liquids.	Infer reasons objects sink or float.	Observe sinking and floating objects. 2,1
3. It is possible to predict results of experiments.	Predict results of an experiment before it is completed.	Hypothesize the outcome of an experiment. 5,10

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

SECOND GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
D. Contributions of Scientists and Science	Students will	
1. Many men and women have contributed to the field of Physical Sciences.	Identify men and women who have contributed to the field of Physical Sciences.	Infer what life might be like without contributions of scientists to the field of Physical Sciences. *5,3
	Describe what men and women have done in the field of Physical Sciences.	Observe the products, inventions, and other findings contributed by men and women in the Physical Sciences. 2,1
2. An understanding of Physical Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Physical Science to function successfully in society.	Communicate the need for learning in the Physical Sciences. 2,4
E. Careers in Science		
1. Numerous careers are available for individuals trained in the Physical Sciences.	Identify careers related to understanding of the Physical Sciences.	Predict which careers depend on understanding of the Physical Sciences. 4,7
2. Many careers depend on a basic knowledge of the Physical Sciences.	Explain how careers depend on understanding of the Physical Sciences.	Communicate how and in what ways careers depend on the Physical Sciences. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

THIRD GRADE

The development of critical thinking and problem-solving skills should be a major goal of the third grade science program. Science instruction at this level should provide students with opportunities to analyze, synthesize, and evaluate information. Program content and activities should focus on familiar, concrete experiences which aid in the development of critical thinking and problem-solving skills.

Three major areas: the Life Sciences, the Earth Sciences, and the Physical Sciences are included. Science topics are animals, plants, fungi, microorganisms, the solar system, resources of the earth, machines, matter and energy, sound, contributions of scientists and science, along with careers in the Life, Earth, and Physical Sciences. Students should develop an understanding of various process skills beginning with the specific and concrete and leading to the general and abstract.

The program should capitalize on the ability of students to gather, understand, apply, and evaluate information. Comprehensive instruction focused on thinking should provide students with the ability to identify and solve problems.

THIRD GRADE

SUGGESTED TIME FRAME		
9 weeks	I.	LIFE SCIENCES
(3 weeks)	A.	Animals 1. Classification of animals 2. Adaptation and survival of animals 3. Interdependence of plants and animals 4. Evidence of prehistoric existence 5. Changes over time 6. Food gathering habits 7. Relation of body parts to specific functions
(4 weeks)	B.	Plants 1. Classification of plants 2. Adaptation to environments 3. Essential needs for growth 4. Edible parts 5. Functional uses
(3 days)	C.	Fungi 1. Mushrooms 2. Helpful and harmful uses
(2 days)	D.	Microorganisms 1. Protozoa 2. Bacteria and viruses
(3 days)	E.	Contributions of Scientists and Science 1. Contributions to the field of Life Science 2. Importance of studying Life Science
(2 days)	F.	Careers in Life Science 1. Career awareness 2. Career preparation
13 weeks	II.	EARTH SCIENCE
(6 weeks)	A.	The Solar System 1. Composition 2. Planetary movements 3. Rotation and revolution of Earth and Moon 4. Rising of the sun

THIRD GRADE

SUGGESTED
TIME FRAME

(6 weeks) B. Resources of the Earth
1. Surface changes
2. Composition of Earth
3. Characteristics of rocks
4. Formation of rocks
5. Composition of soil
6. Uses of soil
7. Conservation of soil

(3 days) C. Contributions of Scientists and Science
1. Contributions to the field of Earth Science
2. Importance of studying Earth Science

(2 days) D. Careers in Earth Science
1. Career awareness
2. Career preparation

14 weeks III. PHYSICAL SCIENCE

(5 weeks) A. Machines and their Uses
1. Simple machines
2. Complex machines
3. Friction and lubrication

(4 weeks) B. Matter and Energy
1. Properties and states of matter
2. Physical changes
3. Effects of temperature
4. Chemical changes
5. Conservation of matter

(4 weeks) C. Sound
1. Production of sound
2. Vibration of sound
3. Sound transmitters

(3 days) D. Contributions of Scientists and Science
1. Contributions to the field of Physical Science
2. Importance of studying Physical Science

(2 days) E. Careers in Physical Science
1. Career awareness
2. Career preparation

THIRD GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
I. LIFE SCIENCE (9 weeks)	Students will	
A. Animals		
1. Animals can be classified by certain characteristics.	Develop a list of meat-eating animals and plant-eating animals.	Classify animals on basis of diets. *4,2
	Identify animals as mammals, reptiles, amphibians, birds, or fish.	Classify animals as mammals, reptiles, amphibians, birds, or fish. 4,2
2. Animals exhibit different adaptations for survival.	Identify animals which migrate, hibernate, change color, or grow heavier coats due to seasonal changes.	Observe animals in selected habitats. 2,1
		Infer animal adaptations for certain habitats. 5,3
	Explore causes of extinction of animals and plants.	Form hypotheses concerning causes of animal extinction. 5,10
3. Plants and animals are interdependent.	Determine that living organisms are dependent on green plants.	Observe animals and plants that depend on each other. 1,1
4. Evidence shows that prehistoric life existed.	Identify an extinct animal.	Infer what environmental conditions cause animals to become extinct. 5,3
5. Animals have changed over a period of time.	Explain that fossils provide clues about animals and plants which lived in prehistoric times.	Observe fossils and compare them to present-day organisms. 2,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

THIRD GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
6. Animals have different methods of gathering and storing food.	Discover ways animals gather and store food.	Communicate ways animals gather and store food. *2,4
7. Structure of body parts is related to specific functions.	Relate body parts of animals to specific functions.	Classify animal body parts on the basis of structure and function. 4,2
B. Plants		
1. Plants can be classified by certain characteristics.	Identify plants by their major characteristics.	Classify plants into major groups. 4,2
	Identify plants according to where they store food.	Classify plants according to where they store food. 4,2
2. Plants adapt to their environments.	Investigate ways by which plants adapt to their environments.	Predict ways by which different types of plants adapt to their environments. 4,7
3. Plants have needs for growth.	Demonstrate and observe that a green plant needs carbon dioxide, water, and energy from the sun to make its food.	Infer that green plants make food from sunlight, water, and carbon dioxide from the air. 5,3
4. Some plants have edible parts.	Identify edible parts of a plant.	Communicate that people eat parts of plants. 2,4
5. Plants have uses.	Explore uses of plants: food, fuel, textiles.	Communicate that plants are helpful and useful to humans. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

THIRD GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
C. Fungi	Students will	
1. Mushrooms are not green plants.	Identify parts of a mushroom.	Observe parts of a mushroom. *1,1
	Compare a mushroom to a green plant.	Classify plants and mushrooms by their characteristics. 2,2
2. Fungi can be both helpful and harmful.	Explore uses of yeasts, molds, and mushrooms.	Communicate that fungi are helpful and useful to humans. 2,4
	Explore harmful effects of fungi.	Communicate that disease and decay are sometimes caused by fungi. 2,4
D. Microorganisms		
1. Protozoa have unique characteristics.	Identify three protozoans.	Communicate that protozoans are neither plants nor animals. 2,4
2. Bacteria and viruses cause disease.	Discuss diseases caused by viruses and bacteria.	Communicate that some illness and diseases can be caused by certain types of microorganisms. 2,4
E. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Life Sciences.	Identify men and women who have contributed to the field of Life Sciences.	Infer what life would be like without contributions of scientists to the field of Life Sciences. 5,3

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
1. Many men and women have contributed to the field of Life Sciences. (continued)	Describe what men and women have done in the field of Life Sciences.	Observe the products, inventions, and other findings contributed by men and women in the Life Sciences. *2,1
2. An understanding of Life Science is neces- to function in today's and tomorrow's society.	Appreciate the need for understanding of Life Science to function successfully in society.	Communicate the need for learning Life Science. 2,4
F. Careers in Science		
1. Numerous careers are available for individuals trained in the Life Sciences.	Identify careers related to understanding of the Life Sciences.	Predict careers which depend on understanding of the Life Sciences. 4,7
2. Many careers depend on a basic knowledge of the Life Sciences.	Explain how careers depend on a basic understanding of the Life Sciences.	Communicate how and in what ways careers depend on the Life Sciences. 2,4
II. EARTH SCIENCE (13 weeks)		
A. The Solar System		
1. There are nine planets in the solar system.	Identify and match names of planets and their positions in the solar system.	Communicate names of planets and their positions in the solar system. 2,4

*The first number refers to the Cognitive Level, the second the Process Skill being emphasized.

THIRD GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Planets orbit around the sun.	Illustrate orbits of the nine planets around the sun.	Formulate a model demonstrating the nine planets as they orbit around the sun. *3,13
3. Rotation and revolution of the earth and moon cause seasonal changes.	Demonstrate causes of day and night.	Experiment to demonstrate causes of day and night. 3,12
	Demonstrate how the earth's axis and orbit are related to seasonal changes.	Observe how movement of the earth causes seasonal changes. 1,1
	Describe movements and phases of the moon.	Observe the moon and name its phases. 1,1
4. The sun rises and sets.	Understand that the sun appears to rise in the east and set in the west.	Infer that the sun rises in the the east and sets in the west. 5,3
B. Resources of the Earth		
1. Changes occur in the surface of the earth.	Observe and discuss changes in the surface of the earth caused by wind, water, and volcanoes.	Infer what kind of effects wind, water, and volcanoes have on the earth's surface. 5,3
2. The composition of the earth is varied.	Identify and understand composition of the earth.	Formulate a model of layers of the earth. 3,13
3. Rocks have distinct characteristics.	Group rocks according to weight, color, smoothness, hardness, or formation.	Classify rocks according to weight, color, smoothness, hardness, or formation. 4,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
4. Rocks are formed by many different forces.	Demonstrate how heat, cold, running water, plants, and people help to break rocks into pieces.	Predict what forces produce certain types of rocks. *4,7
5. Composition of soil is varied.	Identify particles found in a sample of soil.	Observe several samples of soil. 1,1
6. There are many uses of soil.	Discuss uses of soil.	Communicate the importance of soil. 2,4
7. Soil should be conserved.	Explore ways to conserve soil.	Infer importance of soil conservation on living and nonliving things. 5,3
C. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Earth Sciences.	Identify men and women who have contributed to the field of Earth Sciences.	Infer what life might be like without contributions of scientists in the field of Earth Sciences. 5,3
	Describe what men and women have done in the field of Earth Sciences.	Observe products, inventions, and other findings contributed by men and women in the Earth Sciences. 2,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

THIRD GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. An understanding of Earth Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Earth Science to function successfully in society.	Communicate the need for learning in the Earth Sciences. *2,4
D. Careers in Science		
1. Numerous careers are available for individuals trained in the Earth Sciences.	Identify careers related to understanding of the Earth Sciences.	Predict which careers depend on understanding of the Earth Sciences. 4,7
2. Many careers depend on basic knowledge of the Earth Sciences.	Explain how careers depend on a basic understanding of the Earth Sciences.	Communicate how and in what ways careers depend on the Earth Sciences. 2,4
III. PHYSICAL SCIENCE (14 weeks)		
A. Machines and Their Uses		
1. There are many types of simple machines.	Identify machines that help us work.	Observe examples of simple machines. 2,1
	Identify simple machines: levers, pulleys, wedges, screws, inclined planes, wheels.	Classify kinds of machines. 4,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Some machines are complex.	Identify simple machines that compose complex machines.	Classify simple machines found in construction of complex machines. *4,2
3. Friction is created when two things rub against one another.	Discover that friction makes work more difficult and also causes heat.	Experiment to produce heat caused by friction. 3,12
4. Friction can be reduced by lubrication.	Demonstrate how lubrication will reduce friction.	Predict what will happen if a machine is lubricated. 4,7
B. Matter and Energy		
1. States of matter exhibit different properties.	Discover that matter takes up space and has weight.	Observe types of matter. 1,1
	Understand that matter exists in four states: solids, liquids, gases, or plasma.	Classify matter according to the four states: solids, liquids, gases, or plasma. 4,2
	Identify solids, liquids, or gases in the environment.	Observe objects in different states of matter. 1,1
2. Matter undergoes physical changes.	Determine that a change of state or appearance is a physical change.	Experiment with matter to show how it can change from one state to another. 3,12

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
3. Temperature effects matter.	Demonstrate how heat will cause matter to dissolve, melt, or evaporate.	Predict what will happen when heat is applied to a liquid. *4,7
	Predict effects of high temperature on various objects.	Experiment using heat to melt ice and observe evaporation. 4,12
4. Matter undergoes chemical changes.	Demonstrate simple chemical changes.	Interpret data to determine results of chemical change. 4,9
5. Matter can be conserved.	Explore conservation of different forms of matter.	Formulate situations to test conservation of matter. 3,13
C. Sound		
1. Sound can be produced in many ways.	Identify and classify ways of producing sound.	Observe different ways of producing sound. 1,1
2. Sound is a result of vibrations.	Listen and distinguish among soft, high, and low sounds.	Classify sound as soft, high, and low. 2,2
3. Sound can be transmitted.	Determine what forms of matter transmit sound best.	Experiment with different forms of matter to see which ones transmit sound best. 3,12

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
D. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Physical Sciences.	Identify men and women who have contributed to the field of Physical Sciences.	Infer what life might be like without contributions of scientists to the field of Physical Sciences. *5,3
	Describe what men and women have done in the field of Physical Science.	Observe products, inventions, and other findings contributed by men and women in the Physical Sciences. 2,1
2. An understanding of Physical Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Physical Science to function successfully in society.	Communicate the need for learning in the Physical Sciences. 2,4
E. Careers in Science		
1. Numerous careers are available for individuals trained in the Physical Sciences.	Identify careers related to understanding of the Physical Sciences.	Predict careers which depend on understanding of the Physical Sciences. 4,7
2. Many careers depend on a basic knowledge of the Physical Sciences.	Explain how most careers depend upon a basic understanding of the Physical Sciences.	Communicate how and in what ways careers depend on the Physical Sciences. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FOURTH GRADE

Fourth grade is a period of transition for elementary students. In many schools, for the first time, students are faced with changing classrooms and having a "science" teacher. Also, fourth grade is a time when many more abstract scientific concepts are introduced for the first time. From the study of cell division, to plate techtronics and atomic structure, science is no longer an overview of these concepts but instead is the beginning of an indepth study of the Life, Earth, and Physical Sciences. It is also a time when students should develop an ongoing interest in science.

To ensure that all students have the best science instruction possible, the fourth grade curriculum includes concepts from Life, Earth, and Physical Sciences at a variety of levels from the cognitive domain and related to a variety of process skills. Course content involves students in hands-on experiences so that true conceptual understanding will occur.

FOURTH GRADE

SUGGESTED TIME FRAME		
11 weeks	I.	LIFE SCIENCE
(3 weeks)	A.	Characteristics of living things 1. Common characteristics 2. Catagories
(2 weeks)	B.	Groups of Organisms 1. Characteristics of organisms 2. Helpful and harmful organisms 3. Physical characteristics of organisms 4. Helpful and harmful microorganisms
(2 weeks)	C.	Interrelation of Organisms 1. Interdependence of organisms 2. Extinct or endangered species
(3 weeks)	D.	Sense Organs 1. Functions 2. Unique structure
(3 days)	E.	Contributions of Scientists and Science 1. Contributions to the field of Life Science 2. Importance of studying Life Science
(2 days)	F.	Careers in Life Science 1. Career awarnesss 2. Career preparation
16 weeks	II.	EARTH SCIENCE
(4 weeks)	A.	Weather 1. Instruments 2. Effects on people 3. Precipitaton 4. Wind
(5 weeks)	B.	Earth and Its Resources 1. Rock formation 2. Water 3. Soil 4. Effects of pollution 5. Layers of the Earth 6. Surface changes

SUGGESTED
TIME FRAME

(6 weeks)

C. Aerospace
1. Aviation
2. Newton's Third Law
3. Flight processes
4. Modern-day flying

(3 days)

D. Contributions of Scientists and Science
1. Contributions to the field of Earth Science
2. Importance of studying Earth Science

(2 days)

E. Careers in Earth Science
1. Career awareness
2. Career preparation

9 weeks

III. PHYSICAL SCIENCE

(6 weeks)

A. Production, Use, and Conservation of Energy
1. Types of Energy
2. Forms of electricity
3. Electrical energy
4. Heat and light energy
5. Uses of magnets
6. Characteristics of light
7. Molecular movement
8. Physical and chemical changes

(2 weeks)

B. Machines
1. Simple machines
2. Uses

(3 days)

C. Contributions of Scientists and Science
1. Contributions to the field of Physical Science
2. Importance of studying Physical Science

(2 days)

D. Careers in Physical Science
1. Career awareness
2. Career preparation

FOURTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
I. LIFE SCIENCE (11 weeks)	Students will	
A. Characteristics of Living Things		
1. Living things have five common characteristics.	Observe that living things grow, move, reproduce, react, and utilize food.	Observe five characteristics of living things. *1,1
2. Living things can be divided into five categories.	Categorize living organisms as plant, animal, fungi, monera, or protista.	Classify organisms into their respective groups. 4,2
B. Groups of Organisms		
1. Organisms can be grouped according to their characteristics.	Identify characteristics of organisms.	Classify organisms into five groups based on their characteristics. 4,2
2. Organisms can be both helpful and harmful.	Explain ways organisms are useful and helpful to humans.	Communicate ways that organisms are useful or helpful to humans and identify useful organisms. 2,4
	Explain ways organisms are harmful to humans.	Communicate ways organisms are harmful to humans and identify harmful organisms. 2,4
		Classify organisms as either helpful or harmful. 4,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Organisms can be both helpful and harmful. (continued)	Understand that some microscopic animals are useful.	Classify microscopic organisms into helpful, useful, or harmful categories. *4,2
	Identify the insect by its physical characteristics.	Observe physical characteristics of insects. 2,1
	Classify insects as being harmful or helpful.	Infer what would happen if there were no helpful/useful insects. 5,3
		Infer what would happen if there were no harmful insects. 5,3
3. Organisms' eating habits and locomotion are related to physical characteristics.	Describe similarities and differences in organisms' eating habits.	Communicate the types of eating habits displayed by organisms. 2,4
	Describe similarities and differences in locomotion of organisms.	Classify similarities and differences in organisms' locomotion. 4,2
		Predict eating habits and locomotion based on observation of organisms. 4,7
4. Microscopic organisms can be both helpful and harmful.	Understand that diseases are caused by microscopic organisms.	Infer what diseases can be caused by microscopic organisms. 4,3
	Understand that some microscopic organisms are helpful.	Classify helpful microscopic organisms. 3,2

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FOURTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
C. Interrelation of Organisms		
1. Organisms are dependent on one another.	Explore ways that organisms depend on one another.	Observe animals and plants that depend on one another. *2,1
2. Some plants and animals are extinct or becoming endangered.	Identify causes of animal and plant extinction.	Hypothesize what may have caused animals and plants to become extinct. 5,10
	Identify causes of animals and plants becoming endangered.	Communicate methods to protect endangered species. 6,4
D. Sense Organs		
1. The sense organs can be used to understand the environment and protect animals from external forces.	Discuss how the senses can be used to understand environment.	Infer what life would be like without the use of one or more of the senses. *5,3
	Discuss how the senses protect animals from external forces.	Communicate how the senses protect animals from external forces. 3,4
2. Each of the sense organs is unique in structure and function.	Explain different structures and functions of the sense organs.	Formulate a model of the sense organs. 3,13
		Communicate the function of each of the sense organs. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FOURTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
E. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Life Sciences.	Identify men and women who have contributed to the field of Life Sciences.	Infer what life would be like without contributions of scientists to the field of Life Sciences. *5,3
	Describe what men and women have done in the field of Life Sciences.	Observe products, inventions, and other findings contributed by men and women in the Life Sciences. 2,1
2. An understanding of Life Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Life Science to function successfully in society.	Communicate the need for learning in the Life Sciences. 6,4
F. Careers in Life Science		
1. Numerous careers are available for individuals trained in the Life Sciences.	Identify careers related to understanding of the Life Sciences.	Infer careers which depend on the understanding of Life Sciences. 5,3
2. Many careers depend on a knowledge of the Life Sciences.	Explain how careers depend on understanding of the Life Sciences.	Communicate how and in what ways careers depend on the Life Sciences. 6,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FOURTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
II. EARTH SCIENCE (16 weeks)		
A. Weather		
1. Weather information is collected with many kinds of instruments.	Describe various instruments scientists use in collecting data about weather.	Use data from weather instruments to describe the weather. *3,8
2. Weather may have helpful or harmful effects on people.	Discuss what weather conditions mean to the farmer and the consumer.	Classify weather conditions as helpful or harmful to the farmer and the consumer. 4,2
	Discuss the effects of harmful weather.	Predict outcomes of harmful weather. 4,7
		Communicate safety precautions necessary to prepare for harmful weather. 4,7
3. There are four kinds of precipitation: rain, hail, snow, and sleet.	Identify kinds of precipitation: rain, hail, sleet, and snow and the causes of each.	Infer kinds of precipitation that occurs based on weather conditions. 5,3
4. Wind is air in motion caused by uneven heating of the earth's surface by the sun.	Explain how variations in air temperature cause air to move.	Predict what will happen as certain areas of the earth's surface are heated by the sun. 5,7

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
B. Earth and Its Resources		
1. The surface of the earth is made of different kinds of rocks.	Explain what rocks can tell about the earth.	Predict forces that produced certain types of rocks. *5,7
	Learn the differences in formation of the three major groups of rocks.	Formulate a model to display three major groups of rocks. 3,13
	Explain how weather, erosion, deposition, and other forces change the surface of the earth.	Experiment with effects of erosion on different soils. 5,12
		Classify areas on the earth which have been changed by erosion, deposition, weathering, and other forces. 3,2
2. Water covers a large portion of the earth's surface.	Compare the ratio of water to land on the earth's surface.	Formulate a model demonstrating water and land areas of the earth. 4,13
3. Organisms depend directly or indirectly on the soil.	Learn that organisms depend on the soil for existence.	Communicate the importance of soil and soil conservation. 2,4
4. Pollution of land, air, and water is affecting life on the earth.	Explain that pollution of land, air and water is affecting the wellbeing of all life on the earth.	Hypothesize ways to prevent pollution of land, air, and water. 5,10

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FOURTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
5. The earth is constructed in layers.	Identify layers of the earth's interior.	Formulate a model representing layers of the earth. 3,13
	Label a cross section of the earth.	Communicate characteristics of the earth's layers. 2,4
6. The surface of the earth is constantly changing.	Explain how the process of change through actions of volcanoes, earthquakes, and other forces alters the surface of the earth.	Classify mountains according to manner of formation: folded, volcanic, or fault. 2,2
	Describe how coal and other minerals are formed in the earth.	Communicate the history of changing earth through the last four billion years. 2,4
		Classify by areas of the world where coal, gold, silver, and other minerals are formed. 3,2
		Infer how coal and other minerals are formed. 4,3
	Explain how weather, erosion, deposition, and other forces change the surface of the earth.	Experiment with the effects of erosion on different soils. 5,10

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
C. Aerospace		
1. Aviation plays an important part in everyone's life.	Discuss the importance of aviation to the space program.	Interpret data to determine the importance of aviation to the space program. *3,9
	Investigate history of aviation and space travel.	Formulate a model to display history of aviation and space travel. 3,13
2. The definition of Newton's Third Law is essential to understanding aerodynamics.	Explain: For every action there is an opposite and equal reaction.	Experiment and investigate Newton's Third Law. 3,12
3. Drag and gravity must be overcome by lift and and thrust for flight to occur.	Explain the interaction of drag, gravity, lift, and thrust in the process of flight.	Predict outcomes of different designs to analyze drag, gravity, lift, and thrust. 5,7
4. Much work has gone into perfecting modern-day flying.	Know and appreciate efforts of pioneers in aviation.	Communicate information about pioneers in aviation. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FOURTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
D. Contributions of Scientists and Science	Students will	
1. Many men and women have contributed to the field of Earth Sciences.	Identify men and women who have contributed to the field of Earth Sciences.	Infer what life might be like without contributions of scientists to the field of Earth Sciences. *5,3
	Describe what men and women have done in the field of Earth Sciences.	Observe the products, inventions, and other findings contributed by men and women in the Earth Sciences. 2,1
2. An understanding of Earth Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Earth Science to function successfully in society.	Communicate the need for learning in the Earth Sciences. 6,4
E. Careers in Earth Science		
1. Numerous careers are available for individuals trained in the Earth Sciences.	Identify careers related to the understanding of the Earth Sciences.	Communicate careers which depend on understanding of the Earth Sciences. 6,4
2. Many careers depend on knowledge of the Earth Sciences.	Explain how many careers depend on an understanding of the Earth Sciences.	Infer how and in what ways careers depend on the Earth Sciences. 5,3

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FOURTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
III. PHYSICAL SCIENCE (9 weeks)	Students will	
A. Production, Use and Conservation of Energy		
1. Energy can be either potential or kinetic.	Demonstrate potential energy.	Observe types of energy. *2,1
	Demonstrate kinetic energy.	Experiment with potential and kinetic energy. 3,12
2. There are different forms of electricity.	Demonstrate how to produce different forms of electricity.	Classify different forms of electricity. 2,2
3. An electrical circuit can be used to transport energy.	Construct an electrical circuit demonstrating how electricity can be transported.	Observe an electrical circuit noting open and closed circuits. 3,1
4. Electrical energy may be changed to heat or light energy.	Demonstrate how electrical energy may be changed to heat energy.	Observe electrical energy being converted to heat energy. 2,1
	Follow an energy conversion system.	Observe electrical energy being converted to light energy. 2,1
		Define operationally an energy conversion system. 3,14
5. Magnets are used in various ways.	Explore uses of magnets.	Communicate which appliances require magnets in order to work. 2,4
		Predict how magnets can be used to make compasses. 5,7

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
6. Light is a form of energy that shows characteristics of both waves and particles.	Discuss the fact light has characteristics similar to waves and particles.	Communicate characteristics of light. *3,4
	Observe that white light can be reflected to show the colors of the spectrum.	Experiment with a prism to show colors of the spectrum. 4,12
7. Heat causes molecules to move more rapidly.	Understand that rapidly moving molecules have a higher temperature than slowly moving molecules.	Observe temperatures of a variety of substances. 2,1
		Observe objects and infer in which objects the molecules are moving faster. 2,1
8. Matter can be changed physically or chemically.	Identify a physical change.	Observe the process matter undergoes during physical change. 2,1
	Identify a chemical change.	Observe the process matter undergoes during chemical change. 2,1
		Classify changes in matter as either chemical or physical changes. 4,2
B. Machines		
1. There are six basic machines.	Identify six basic machines.	Classify six basic machines. 2,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Machines make work easier.	Explore everyday examples of how simple machines make work easier.	Observe examples of simple machines. *2,1 Experiment with simple machines to make work easier. 3,12 Classify simple machines used in the construction of complex machines. 4,2
C. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Physical Sciences.	Identify men and women who have contributed to the field of Physical Sciences.	Infer what life might be like without the contributions of scientists to the field of Physical Sciences. 5,3
	Describe what men and women have done in the field of Physical Sciences.	Observe products, inventions, and other findings contributed by men and women in the Physical Sciences. 2,1
2. An understanding of Physical Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Physical Science to function successfully in society.	Communicate the need for learning in the Physical Sciences. 6,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FOURTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
D. Careers in Physical Science	Students will	
1. Numerous careers are available for individuals trained in the Physical Sciences.	Identify careers related to understanding of the Physical Sciences.	Communicate careers which depend on understanding of the Physical Sciences. *6,4
2. Many careers depend on a knowledge of the Physical Sciences.	Explain how careers depend on understanding of the Physical Sciences.	Infer how and in what ways careers careers depend on the Physical Sciences. 5,3

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FIFTH GRADE

Fifth grade science includes the Life, Earth, and Physical Sciences as well as contributions to these fields, careers in science, and suggestions for inclusion of process skills in the curriculum.

The Life Sciences involve students in the study of organisms, their structure and classification. Earth Sciences include study of weather, oceanography, the land and its resources, and a study of space. The Physical Sciences require students to construct models, design experiments, make and record observations, and formulate conclusions as a result of these activities. Topics included are matter and energy, sound and energy, and the production and consumption of energy.

Units on contributions made by scientists to the field of science should acquaint students with persons who have been instrumental in changing lives through scientific principles and discoveries. The career unit should make them aware of the number of occupations which are science-related or require some knowledge of scientific procedures and principles.

Throughout the entire fifth grade science program, process skills which help students understand concepts being presented and a hands-on approach to teaching should be used in classroom instruction.

FIFTH GRADE

SUGGESTED TIME FRAME		
7 weeks	I.	LIFE SCIENCE
(3 weeks)	A.	Organisms 1. Classification of organisms 2. Cells, tissues, and organs 3. Interdependence of organisms
(3 weeks)	B.	Growth and Maintenance 1. Life cycles 2. Need for food and oxygen 3. Digestive system 4. Circulatory system
(3 days)	C.	Contributions of Scientists and Science 1. Contributions to the field of Life Science 2. Importance of studying Life Science
(2 days)	D.	Careers in Life Science 1. Career awareness 2. Career preparation
16 weeks	II.	EARTH SCIENCE
(3 weeks)	A.	Weather 1. Weather factors 2. Effects of weather 3. Controlling weather 4. Seasonal changes
(4 weeks)	B.	Oceanography 1. Importance to people 2. Life in the ocean 3. Underwater exploration
(4 weeks)	C.	The Land and Its Resources 1. Layers of Earth 2. Physical features 3. Rocks 4. Minerals 5. Conservation

SUGGESTED TIME FRAME		
(4 weeks)		D. Space 1. Components of the solar system 2. Relationship of moon and tide 3. Exploration
(3 days)		E. Contributions of Scientists and Science 1. Contributions to the field of Earth Science 2. Importance of studying Earth Science
(2 days)		F. Careers in Earth Science 1. Career awareness 2. Career preparation
13 weeks	III.	PHYSICAL SCIENCE
(4 weeks)		A. Matter and Energy 1. States of matter 2. Structure of matter 3. Elements, compounds, and mixtures 4. Physical and chemical changes
(4 weeks)		B. Sound and Energy 1. Production and characteristics of sound 2. Speech organs 3. Sense of hearing
(4 weeks)		C. Production, Consumption, and Conservation of Energy 1. Newton's Third Law 2. Electrical and mechanical energy 3. Magnetism 4. Heat energy
(3 days)		D. Contributions of Scientists and Science 1. Contributions to the field of Physical Science 2. Importance of studying Physical Science
(2 days)		E. Careers in Physical Science 1. Career awareness 2. Career preparation

FIFTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
I. LIFE SCIENCE (7 weeks)	Students will	
A. Organisms		
1. Organisms are classified by their characteristics.	Understand that scientists classify organisms systematically by their characteristics.	Observe a variety of organisms. *1,1
	Group animals into major categories of vertebrates and invertebrates by their characteristics.	Communicate differences among animal phyla. 5,4
	Group plants into four phyla by their characteristics.	Communicate differences among plant phyla. 5,4
	Identify types of fungi by characteristics.	Classify fungi into general categories. 4,2
	Identify major groups of bacteria and viruses.	Communicate differences among bacteria and viruses. 2,4
	Identify basic groups of common protozoans.	Observe both live and mounted protozoans. 1,1
2. Organisms are composed of cells, tissues, or organs.	Identify differences between plant and animal cells.	Observe differences between plant and animal cells. 1,1
	Understand that different cells have different functions.	Communicate functions of cells. 2,4
	Understand that cells are organized into tissues with specific functions.	Communicate functions of tissues. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Organisms are composed of cells, tissues, or organs. (continued)	Understand organs and organ systems have specific functions.	Communicate role of organ systems. *2,4
3. Plants and animals are dependent on one another.	Understand that many plants and animals have become extinct and others are endangered.	Observe that manipulation of the environment has caused some plants and animals to become endangered or extinct. 4,1
	Discover why some plants and animals are becoming endangered and how they can be protected.	Communicate how endangered plants and animals can be protected. 2,4
		Predict the possibility of extinction of a plant or animal. 4,7
	Discover how plants and animals adapt to environmental conditions.	Experiment with plants in different environmental conditions. 3,12
		Predict outcomes if habitats of plants or animals are altered. 5,7
B. Growth and Maintenance		
1. Plants and animals have different life cycles.	Examine life cycles of plants and animals.	Observe plant and animal life cycles. 1,1
2. Living things need food and oxygen.	Understand that living things must have food and oxygen to survive.	Communicate dependence of living things on production of energy. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FIFTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Living things need food and oxygen. (continued)	Explain how plants make food.	Experiment with plants to determine significance of photosynthesis. *3,12
	Explore role of green plants in production of oxygen.	Infer importance of green plants in production of oxygen. 5,3
3. Organs which compose the digestive system work together.	Discuss digestion and effects of enzymes on food.	Observe effects of enzymes on food we eat. 4,1
	Explain the process of diffusion through an animal membrane.	Experiment with diffusion through an animal membrane. 3,12
	Explain that digested food is utilized in each cell.	Communicate that digested food is utilized in each cell. 2,4
4. Organs which compose the circulatory system work together.	Discuss organs of the circulatory system.	Observe organs of the circulatory system. 4,1
	Explain the function of blood.	Communicate that blood circulates to all parts of the body and back to the heart. 2,4
	Discuss components of blood and the function of each.	Observe liquid plasma, red blood cells that carry oxygen, and white blood cells that fight germs. 4,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
C. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Life Sciences.	Identify men and women who have contributed to the field of Life Sciences.	Infer what life would be like without contributions of scientists to the field of Life Sciences. *5,3
	Describe what men and women have done in the field of Life Sciences.	Observe products, inventions, and other findings contributed by men and women in the Life Sciences. 2,1
2. An understanding of Life Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Life Science to function successfully in society.	Communicate the need for learning in the Life Sciences. 6,4
D. Careers in Life Science		
1. Numerous careers are available for individuals trained in the Life Sciences.	Identify careers related to understanding of the Life Sciences.	Infer careers which depend upon understanding of the Life Sciences. 6,4
2. Many careers depend on a knowledge of the Life Sciences.	Explain how careers depend upon understanding of the Life Sciences.	Communicate how and in what ways careers depend on the Life Sciences. 5,3

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
II. EARTH SCIENCE (16 weeks)		
A. Weather		
1. Many factors affect the weather.	Describe ways heat energy, water movement, and air movement affect weather.	Formulate models of weather systems across the United States. *4,13
	Define the weather terms: lows, highs, fronts, precipitation.	Communicate a knowledge of terms used to describe weather. 2,4
	Explain how changes in ocean currents affect weather.	Infer effects on weather caused by changes in major ocean currents. 5,3
2. Weather affects the earth.	Explain effects weather has on plans for recreational activities or travel.	Communicate how weather has caused a change in some activity. 2,3
	Explain how weather determines cost or availability of food.	Observe that cost or availability of certain foods changes during different seasons or after a major weather disaster. 4,1
	Explain results in loss of lives and damage to property caused by hurricanes, tornadoes, or other weather phenomena.	Interpret data to determine the magnitude of property damage and loss of lives due to weather phenomena. 5,9

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CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Weather affects the earth. (continued)	Explain how prewarning forecasts save lives and property when tornadoes, hurricanes, floods, or freezes occur.	Communicate safety precautions to be taken when dangerous weather conditions are present. *2,4
	Explain how pollutants at low levels in the air cause heat inversions to occur.	Formulate a model demonstrating a heat inversion. 3,13
3. Weather can be controlled by various	Examine how rainmaking chemicals are used in an effort to control weather.	Infer results if rainmaking chemicals caused too much rainfall. 4,3
		Predict consequences of using rainmaking chemicals over desert regions of the world. 5,7
		Communicate uses of rainmaking chemicals in efforts to control weather. 2,4
	Explain how arid areas of the world are made habitable.	Communicate how an irrigation system works. 2,4
4. Plants and animals adapt to seasonal changes.	Explore how plants and animals have adapted to seasonal changes.	Communicate how different plants and animals adapt to seasonal changes. 2,4

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FIFTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
B. Oceanography		
1. The ocean is an important part of our lives.	Understand that the ocean covers approximately three-fourths of the earth's surface.	Interpret data to determine the amount of the earth's surface covered by water. *4,9
	Discuss importance of the ocean in our lives.	Communicate ways in which the ocean is important to all people. 2,4
2. Life abounds in the ocean.	Explain how salinity, temperature, depth, and light affect amount and kinds of life in the ocean.	Communicate how salinity, temperature, depth, and light affect the amount and kinds of life in the ocean. 2,4
	Describe geological formations and features found on the ocean floor.	Classify geological formations and features found on the ocean floor. 4,2
3. Underwater exploration is being conducted.	Describe special types of equipment necessary for underwater exploration.	Communicate how water pressure affects design and construction of equipment for underwater exploration. 5,4
		Infer what type of equipment is necessary to explore a ship wreck or trench on the ocean bottom. 5,3

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CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
C. The Land and Its Resources		
1. The earth is composed of different layers.	Describe three layers that compose the earth.	Formulate a model showing three layers of earth. *3,13
	Understand that anything made of cement, plaster, or glass contains matter from the earth's crust.	Use numbers to show the amount of materials used daily which come from materials in the earth's crust. 3,8
2. The earth has many different physical features.	Explain that external forces can cause changes in the earth's crust.	Formulate a model of a volcano. 3,13
		Communicate the effect of earthquakes on land masses. 2,4
3. Rocks and soil are components of the earth.	Describe properties of rocks.	Classify rocks according to their properties. 4,2
		Communicate differences among igneous, metamorphic, and sedimentary rocks. 2,4
	Explain how soil is formed when rocks break apart.	Observe samples of different soils for comparison and test each to determine its properties. 2,1
	Explain why top soil must be preserved.	Communicate reasons for conserving top soil. 2,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FIFTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
3. Rocks and soil are components of the earth. (continued)	Study causes and effects of erosion.	Experiment with effect of erosion on land formations. *3,12
	Discuss methods of conserving soil and water.	Communicate methods used to conserve soil and water. 2,4
4. Minerals are resources found on the earth.	Explain that natural elements or compounds in the earth's crust are minerals.	Observe minerals found in the earth's crust. 1,1
	Identify minerals by testing their properties.	Experiment to identify minerals by testing their properties. 3,12
5. The earth's resources must be conserved.	Understand that minerals on the earth are being used faster than they are being formed.	Communicate ways of conserving minerals. 2,4
		Infer results if the earth's supply of minerals is depleted. 5,3
		Interpret data from charts which show increasing use of earth's mineral reserves. 5,9
		Use numbers to compare former use of minerals with present day use. 3,8
	Explain why some minerals are in short supply and what should be done to conserve them.	Communicate what should be done to conserve earth's minerals. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FIFTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
D. Space		
1. The solar system is composed of the sun, planets, satellites, comets, and asteroids.	Explain components of the solar system: sun, planets, their satellites, meteors, comets, asteroids.	Formulate a model of a solar system. *3,13
	Explain that the sun is the center of the solar system and the planets revolve and rotate in orbit around it.	Interpret data to determine distances between the planets and the sun. 5,9
	Explain the difference between refracting and reflecting telescopes.	Observe refracting and reflecting telescopes. 2,1
	Determine distance between the moon and the earth.	Use numbers to compare and contrast time necessary for various modes of transportation to reach the moon from the earth. 3,8
	Discuss light years as units of measure for distances between objects in the solar system and beyond.	Use numbers to determine time in light years required to travel from the earth to various planets and stars. 3,8
2. There is a relationship between tides and the moon.	Describe the phases of the moon.	Design an experiment which demonstrates phases of the moon. 3,12
	Explain how phases of the moon and tides are related.	Formulate a model demonstrating tides. 3,13

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FIFTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. There is a relationship between tides and the moon. (continued)	Explain how the surface of the moon has been shaped by volcanic activity, gravity, and meteors.	Communicate how the surface of the moon has been shaped by volcanic activity, gravity, and meteors. *4,4
		Formulate a model depicting the surface of the moon. 3,13
3. Space exploration is a vital and ongoing process.	Discuss problems associated with acceleration, weightlessness, radiation, deceleration, and distance in space travel.	Predict the feeling of traveling in space. 4,7
	Investigate the benefits to mankind of space exploration.	Communicate reasons exploration of space should continue. 2,4
		Predict what discoveries and outcomes may occur in the future because of space exploration. 4,7
E. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Earth Sciences.	Identify men and women who have contributed to the field of Earth Sciences.	Infer what life might be like without contributions of scientists to the field of Earth Sciences. 5,3
	Describe what men and women have done in the field of Earth Sciences.	Observe the products, inventions, and other findings contributed by men and women in the Earth Sciences. 2,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. An understanding of Earth Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Earth Science to function successfully in society.	Communicate the need for learning in the Earth Sciences. *6,4
F. Careers in Earth Science		
1. Numerous careers are available for individuals trained in the Earth Sciences.	Identify careers related to the understanding of the Earth Sciences.	Communicate careers which depend on understanding of the Earth Sciences. 6,4
2. Many careers depend on knowledge of the Earth Sciences.	Explain how most careers depend on an understanding of the Earth Sciences.	Infer how and in what ways careers depend on the Earth Sciences. 5,3
III. PHYSICAL SCIENCE (13 weeks)		
A. Matter and Energy		
1. There are four states of matter.	Identify substances that represent the four states of matter: solids, liquids, gases, and plasma.	Classify matter as solid, liquid, gas, or plasma. 3,2
	Discover effects of heat or cold on molecules of matter.	Experiment with effect of heat and cold on molecules of matter. 4,12
	Discover the effect of heat on water.	Observe the effect of heat on water. 2,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FIFTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Matter is composed of molecules and atoms.	Discover that matter is composed of small particles called molecules.	Formulate models of certain molecular structures. *3,13
	Discover effects of heat or cold on molecules of matter.	Experiment with effect of heat and cold on molecules of matter. 4,12
	Discover that molecules are composed of particles called atoms.	Communicate that molecules are composed of particles called atoms. 5,4
3. Matter exists as elements, compounds, and mixtures.	Explain composition of elements, compounds, and mixtures.	Classify matter as either an element, a compound, or a mixture. 4,2
4. Matter undergoes physical and chemical changes.	Explain a physical change in matter.	Observe examples of evaporation. 2,1
		Observe other examples of physical changes in matter. 2,1
	Explain a chemical change in matter.	Observe examples of chemical changes in matter. 2,1
	Compare and contrast a physical change and a chemical change in matter.	Classify changes in matter as physical or chemical. 4,2
B. Sound and Energy		
1. Sound can be produced and has certain characteristics.	Explain how sound is produced.	Communicate that sound is produced through vibration of an object. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

FIFTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
1. Sound can be produced and has certain characteristics. (continued)	Describe characteristics of sound: pitch, volume, timbre.	Observe differences in characteristics of sound: pitch, volume, timbre. *2,1
	Explain uses of sound energy.	Communicate how sound energy is used in medicine and other areas. 5,4
2. Speech organs have many functions.	Explain functions of lungs, larynx, lips, tongue and teeth.	Infer how speech organs work together to form sound. 4,3
3. Care of the ears is important.	Describe parts of the ear and their functions in hearing.	Formulate a model of the ear showing parts and their functions in hearing. 3,13
	Explain ways of protecting the sense of hearing.	Communicate ways to protect the sense of hearing. 3,4
	Appreciate the sense of hearing.	Infer what would result if the sense of hearing were lost. 4,3
C. Production, Consumption, and Conservation of Energy		
1. Understanding Newton's Third Law is essential to understanding conservation of energy.	Explain: For every action there is an opposite and equal reaction.	Experiment and investigate Newton's Third Law. 3,12

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FIFTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Two forms of energy are electrical energy and mechanical energy.	Explain a simple electrical circuit.	Formulate a model of a simple electrical circuit. *3,13
	Discover uses of electrical energy.	Experiment with various uses of electrical energy. 4,12
	Discover uses of mechanical energy.	Communicate uses for mechanical energy. 2,4
	Identify an example of electrical energy changed to mechanical energy.	Observe electrical energy being changed into mechanical energy. 2,1
3. Magnetism plays an important role in energy production.	Explore uses of magnets.	Communicate appliances that use magnets in order to work. 2,4
		Predict how magnets can be used to make compasses. 5,7
	Explain how a magnet works.	Observe magnetic fields on a variety of magnets. 2,1
	Discover the difference between bar magnets and electromagnets.	Communicate difference between bar magnets and electromagnets. 2,4
4. Heat is a form of energy.	Explain heat energy.	Communicate what heat energy is. 2,4
	Identify materials that are conductors and nonconductors of energy.	Classify materials as conductors or nonconductors of energy. 3,2
	Discover substances which do and do not conduct heat.	Observe substances which do and do not conduct heat. 2,1

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CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
D. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Physical Sciences.	Identify men and women who have contributed to the field of Physical Sciences.	Infer what life might be like without the contributions of scientists to the field of Physical Sciences. *5,3
	Describe what men and women have done in the field of Physical Sciences.	Observe products, inventions, and other findings contributed by men and women in the Physical Sciences. 2,1
2. An understanding of Physical Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Physical Science to function successfully in society.	Communicate the need for learning in the Physical Sciences. 6,4
E. Careers in Physical Science		
1. Numerous careers are available for individuals trained in the Physical Sciences.	Identify careers related to understanding of the Physical Sciences.	Communicate careers which depend on understanding of the Physical Sciences. 6,4
2. Many careers depend on a knowledge of the Physical Sciences.	Explain how careers depend on understanding of the Physical Sciences.	Infer how and in what ways careers depend on the Physical Sciences. 5,3

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

SIXTH GRADE

Sixth grade science should build conceptual understanding of scientific principles, laws, and theories. It should develop critical thinking and problem-solving skills as the higher level process skills are acquired by students. By this grade level, students should have positive attitudes toward science and the scientific enterprise. Teachers of science at this grade level should help students build an understanding of the need for scientifically and technologically literate citizens.

Implementation of the sixth grade science curriculum as outlined on the following pages allows students to discover the world of science for themselves. The concepts and skills are extensions of the knowledge and processes acquired in previous grade levels. Teachers and students working together to accomplish the instructional objectives for the sixth grade program should produce not only individuals with respect for the importance of science in today's and tomorrow's world but also individuals prepared and eager to continue with more advanced science coursework in the middle school, junior and senior high schools.

SIXTH GRADE

SUGGESTED
TIME FRAME

15 weeks — I. LIFE SCIENCE

(3 weeks) — A. Basic Structure of Life
1. Cells and life functions
2. Plant and animal cells
3. Growth and cell division
4. Reproduction
5. Heredity
6. Survival

(6 weeks) — B. Organisms
1. Adaptations of living things
2. Survival traits
3. Interdependence of living things
4. Adjustable changes
5. Classification
6. Comparison of ecosystems
7. Functions of plant parts
8. Plant structures
9. Stages of plants
10. Reproduction
11. Bees and pollination
12. Special structures of bees
13. Similarities and differences among living things
14. Ordering living things
15. Food chains and food webs
16. Primary producers
17. Uses of living things by man

(4 weeks) — C. The Human Body
1. Body systems
2. Skeletal system
3. Bone marrow
4. Special functions of bones
5. Interactions of bones and joints
6. Movement of joints
7. Interaction of skeletal and muscular systems
8. Provisions of skeletal and muscular systems
9. Diseases that affect skeletal and muscular systems
10. Causes and methods of preventing disease
11. Tools of the digestive system
12. Composition of teeth

SUGGESTED
TIME FRAME

(3 days)

D. Contributions of Scientists and Science
   1. Contributions to the field of Life Science
   2. Importance of studying Life Science

(2 days)

E. Careers in Life Science
   1. Career opportunities
   2. Career preparation

(1 week)

F. Experimental Situations
   1. Investigations
   2. Conclusions

9 weeks

II. EARTH SCIENCE

(2 weeks)

A. The Atmosphere. Hydrosphere, and Earth
   1. Elements of the atmosphere
   2. Layers of the atmosphere
   3. Water pressure
   4. Layers of the earth
   5. Water vapor and temperature
   6. Ocean currents
   7. Interactions of air and water

(3 weeks)

B. Weather
   1. Formation of clouds
   2. Types of clouds
   3. Air masses
   4. Fronts
   5. Weather instruments
   6. Function of meteorologists
   7. Conditions
   8. Movement of air masses
   9. Weather maps

(2 weeks)

C. Space
   1. Projects and discoveries
   2. Technological advances
   3. Telescopes
   4. Radio telescopes
   5. Observations in space
   6. Conditions in space

(3 days)

D. Contributions of Scientists and Science
   1. Contributions to the field of Earth Science
   2. Importance of studying Earth Science

SUGGESTED
TIME FRAME

(2 days)

E. Careers in Earth Science
   1. Career opportunities
   2. Career preparation

(1 week)

F. Experimental Situations
   1. Investigations
   2. Conclusions

12 weeks

III. PHYSICAL SCIENCE

(6 weeks)

A. Matter and Energy
   1. Qualities of matter
   2. States of matter
   3. Common properties
   4. Special properties
   5. Atoms and molecules
   6. Parts of atoms
   7. Radioactive elements
   8. Detecting radioactive elements
   9. Power of radioactive rays
   10. Elements
   11. Compounds
   12. Mixtures
   13. Chemical changes
   14. Physical changes
   15. Nuclear changes
   16. Energy and changes

(4 weeks)

B. Production, Consumption, and Conservation of Energy
   1. Newton's Third Law of Motion
   2. Forms of energy
   3. Alternate energy sources
   4. Conservation of energy
   5. Heat energy
   6. Refraction of light
   7. Reflection of light
   8. Characteristics of electricity
   9. Electrical circuits
   10. Construction of electrical circuits
   11. Magnets

SUGGESTED TIME FRAME	
(3 days)	C. Contributions of Scientists and Science 1. Contributions to the field of Physical Science 2. Importance of studying Physical Science
(2 days)	D. Careers in Physical Science 1. Career opportunities 2. Career preparations
(1 week)	E. Experimental Situations 1. Investigations 2. Conclusions

SIXTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
I. LIFE SCIENCE (15 weeks)	Students will	
A. Basic Structure of Life		
1. Cells are the basic component of all living things.	Describe structures that compose plant and animal cells and the function of each.	Formulate models of plant and animal cells. *3,13
2. Cells can be classified as plant or animal.	Differentiate between plant and animal cells.	Observe plant and animal cells. 1,1 Classify plant and animal cells. 4,2
3. Growth occurs through cell division.	Name and identify methods of cell division and reproduction.	Formulate models of cell division. 3,13
4. Survival through different methods of reproduction protects species.	Discuss the role of genes that pass on characteristics of parents.	Observe differing characteristics of plants and animals. 1,1
5. Desirable traits can be encouraged and improved on.	Create situations to test specific traits of animals.	Observe outcomes of controlled hereditary characteristics. 2,1
6. Traits acquired by means of adaptation are strengthened through survival.	Evaluate conditions promoting acquisition of specific traits.	Hypothesize consequences of certain hereditary characteristics and how they might be used to refine or to destroy species of plants and animals. 5,10

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
B. Plant and Animal Worlds	Students will	
1. Special features of plants and animals allow them to survive.	Identify structures of plants and animals which allow them to function successfully and survive.	Formulate models of specific living things. *3,13
2. Gradual changes in environment cause plants and animals to produce special survival traits.	Recognize traits to ensure survival that have evolved over time.	Infer explanations of importance of certain adaptive features. 5,3
3. Living things have specific basic needs and are interdependent.	Give examples of basic needs of organisms.	Predict changes that would occur if needs of living things were altered. 4,7
4. Changes that occur in the environment cause changes in living things.	Describe changes that could occur in the environment and ways living things things could adjust to new conditions.	Communicate relationships that exist between living things and their environments. 5,4
5. Organisms are classified by groups.	Compare relationships of organisms to each other and to each other's environments.	Formulate models of different habitats. 3,13
6. Specific organisms share habitats with varying climactic conditions and inter-relationships.	Separate groups of living things according to their special features.	Classify similarities and differences which aid scientists in organizing and grouping organisms. 4,2

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SIXTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
7. Structures of plants are related to functions of the plants.	Name and identify plant structues.	Communicate functions of plant structures. *3,4
8. Many plant structures change throughout the seasons.	Identify plant structures that are altered with the change of seasons.	Separate and control variables to show how changes in plant structures are related to seasonal changes. 5,11
9. Plants have a series of stages through which they pass.	Identify the flowering stage of plants.	Observe the variety of the flowering stages. 1,1
10. Plants reproduce by production of seeds or by sexual reproduction with the flower being the sexual organ.	Describe functions of the parts of a flower involved in reproduction.	Communicate the usefulness of design of special plant parts. 4,4
11. Bees and other insects transfer pollen from flower to flower.	Describe the relationship of the bee and other insects to flowers and their environments.	Communicate the purpose of these special attractions and relationships. 5,4
12. Pollen can be carried by the bee in special pollen baskets.	Identify the special structure of the bee that allows it to carry pollen.	Formulate a model of the bee's special structure and the other unique characteristics of insects. 5,13
13. Living things are grouped according to overall similarities not a single feature.	Separate groups of living things according to their special features.	Classify living things according to specific features that separate them from other living things. 4,2

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CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
14. Living things have been given names to facilitate communication.	Separate living things into three groups: category, name, and characteristics.	Communicate the purpose of ordering living things according to an international language (Latin). *5,4
15. Energy passes from organism to organism through a specific food chain.	Describe the flow of energy through specific organisms.	Formulate models of food chains. 3,13
16. Plants are primary producers of energy on land.	Understand the process of photosynthesis (light energy converted to chemical energy) and observe that all living things depend on food.	Predict outcomes of disturbing or altering the habitats of primary producers. 6,7
17. Living things provide opportunities for people to prosper physically, mentally, and socially.	Explain ways living things are used for food, medicine, materials, education, and emotional needs.	Communicate usefulness of living things in making a better life for mankind. 5,4
C. The Human Body		
1. Systems of the body are interrelated and depend on each other to function properly.	Identify systems which compose the human body.	Observe a model of a human torso. 1,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. The organs of the skeletal system are bones which provide the framework of the body, a means of attachment for skeletal muscles, and protection for delicate structures.	Name and identify different types of bones.	Observe a model of a human skeleton. *1,1 Formulate models of the skeletal system. 3,13 Communicate the relationship of specific bones to their functions. 4,4
3. The marrow found in special bones is responsible for producing red and white blood cells.	Identify special functions of bone tissue.	Classify organs of the skeletal system according to their functions. 4,2
4. Bones store calcium and phosphorus.	Explain the roles of calcium and phosphorus in the body.	Infer the usefulness of bones in the storage and release of calcium and phosphorus. 5,3
5. The interaction between bones at the point of contact is called a joint.	Identify different types of joints.	Observe different types of joints. 1,1 Infer that different shapes of bones are compatible with the tasks they perform. 5,3 Experiment with movement to illustrate how different joints and muscles move. 5,3

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
6. Joints may be stationary, have limited movement, or move freely.	Describe movements of specific joints.	Infer the usefulness of specific joints and their ability to move. *5,3
7. The skeletal and the muscular systems partially compose the human body.	Describe specific activities of the body that require uses of the muscular and skeletal systems.	Communicate the relationship between specific muscles and bones which provide movement. 4,4
8. The skeletal and muscular systems work together to provide support, shape, protection, and movement to the body.	Identify function and composition of the skeletal system.	Separate and control variables to show the interdependence of body systems in completing specific functions. 5,11
9. Various diseases affect the systems of the body.	Describe specific diseases that affect muscles, teeth, and bones.	Define specific diseases, their possible causes, and their effects on muscles, teeth, and bones. 5,14
10. Diseases have causes and can be prevented.	Identify causes of specific diseases and methods of preventing them.	Infer methods of preventing diseases. 5,3
11. Teeth are made of calcium and are tools of the digestive system.	Describe ways teeth can be associated with different body systems.	Communicate the relationship of teeth to the skeletal system. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

SIXTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
12. Teeth have different different shapes which enable them to perform specific functions.	Describe specific shapes of teeth and functions they perform.	Communicate the relationship of a tooth to its specific function. *4,4
D. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Life Sciences.	Identify men and women who have contributed to the field of Life Sciences.	Infer what life would be like without contributions of scientists to the field of Life Sciences. 5,3
	Describe what men and women have done in the field of Life Sciences.	Observe products, inventions, and other findings contributed by men and women in the Life Sciences. 2,1
2. An understanding of Life Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Life Science to function successfully in society.	Communicate the need for learning in the Life Sciences. 2,4
E. Careers in Life Science		
1. Numerous careers are available for individuals trained in the Life Sciences.	Identify careers related to understanding of the Life Sciences.	Infer careers which depend on understanding of the Life Sciences. 2,2

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Many careers depend on a knowledge of the Life Sciences.	Explain how careers depend on understanding of the Life Sciences.	Communicate how and in what ways careers depend on the Life Sciences. *2,4
F. Experimental Situations		
1. Scientific investigations are composed of specific procedures.	Compose exercises which require use of scientific investigation.	Form hypotheses to test results of investigations. 5,10
2. Conclusions can be drawn from scientific investigations.	Describe results of experimental observations.	Interpret data from observations and form conclusions. 5,9
II. EARTH SCIENCE (9 weeks)		
A. The Atmosphere, Hydrosphere, and Earth		
1. Earth's atmosphere is composed of different elements.	Identify solids, liquids, and gases that combine to form earth's atmosphere.	Formulate a model of the layers of the atmosphere and identify special characteristics of each. 3,13
2. Layers of air have distinguishing physical properties.	Discuss characteristics of atmospheric layers.	Communicate distinguishing characteristics of atmospheric layers. 2,4

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

SIXTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
3. Water exerts pressure that increases in proportion to its depth.	Describe means of computing pressure of water in the ocean.	Using numbers, calculate water pressure. *5,8
		Predict effects of air and water pressure on the body. 4,7
4. Earth has a core, a mantle, and a crust.	Discuss characteristics of layers of Earth.	Construct a model of the earth's layers. 3,13
	Natural forces constantly alter Earth's layers.	Communicate natural forces and their effects on earth. 2,4
5. The amount of water vapor air contains is dependent on temperature of the air.	Compare temperatures of air to amounts of water vapor it holds.	Using numbers, calculate relative humidity and dew point. 3,8
6. Differences in air temperature cause ocean currents.	Describe influence of ocean currents on climate and oceanic transportation.	Communicate effects of ocean currents. 2,4
7. Interaction of water and air directly influences weather conditions.	Discuss specific influences air and water have on weather.	Infer effects of warm and cold currents of air and water on weather conditions. 2,3

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
B. Weather	Students will	
1. Clouds are formed from ice crystals or vapor.	Describe formation of clouds.	Communicate formation of a cloud. *2,4
2. Clouds have various formations.	Describe various cloud formations.	Construct models of different cloud formations. 2,13
3. Weather is affected by air masses.	Identify air masses that influence weather conditions in the United States.	Hypothesize consequences of air masses and how changes in air can alter weather. 5,10
4. Weather is affected by high and low pressure areas and fronts.	Evaluate conditions caused by high and low pressure areas and fronts.	Infer weather resulting from warm or cold air and high or low pressure areas. 5,3
5. Weather instruments collect data on temperature, humidity, air pressure, wind velocity, and precipitation.	Identify weather instruments and the data supplied by each.	Formulate models of weather instruments and record the data collected by them. 3,13
6. Meteorologists and the Weather Bureau obtain information about atmospheric conditions to help people prepare for conditions that influence their lives.	Describe cloud formations and climate conditions they forecast. Explain how weather conditions influence day-to-day activities.	Observe clouds and predict weather conditions. 3,7 Communicate effects of weather conditions using graphs. 2,4

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CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
7. Weather is affected by combinations of conditions.	Describe various weather conditions.	Predict weather based on observations and data collection. *5,7
8. Cold and warm air develop over the surface of the earth and move across the earth.	Describe cold and warm air masses and how they affect weather.	Observe and communicate movement of air masses across the United States. 2,4
9. Weather maps use special symbols to denote weather conditions.	Identify symbols on a weather map.	Construct a model of a weather map. 3,13
C. Space		
1. Recent information has increased knowledge of the moon, the solar system, and the universe.	Describe special space projects and discoveries each made.	Classify information gathered from special space projects. 2,2
2. Research in design projects has resulted in technological advances.	List advances in technology that resulted from space exploration.	Predict advances in technology in the future. 3,7
3. Telescopes are used to observe distant objects.	Identify types of telescopes and describe how they operate.	Formulate models of telescopes. 3,13

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CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
4. Radio telescopes are used to predict information about distant objects.	Explain how a radio telescope gathers information.	Observe information gathered from a radio telescope. *1,1
5. Space cameras record distant objects on film.	Describe ways photographs can increase knowledge of the universe.	Observe photographs from space. 1,1 Infer how photographs may be used in the future 2,3
6. Compare and contrast conditions in space and atmospheric conditions on earth.	Explain likenesses and differences of atmospheric conditions in space and those on earth.	Infer ways life in space might be different from life on earth. 2,3
D. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Earth Sciences.	Identify men and women who have contributed to the field of Earth Sciences.	Infer what life might be like without contributions of scientists to the field of Earth Sciences. 5,3
	Describe what men and women have done in the field of Earth Sciences.	Observe the products, inventions, and other findings contributed by men and women in the Earth Sciences. 2,1

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CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. An understanding of Earth Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Earth Science to function successfully in society.	Communicate the need for learning in the Earth Sciences. *6,4
E. Careers in Earth Science		
1. Numerous careers are available for individuals trained in the Earth Sciences.	Identify careers related to the understanding of the Earth Sciences.	Communicate careers which depend on understanding of the Earth Sciences. 6,4
2. Many careers depend on knowledge of the Earth Sciences.	Explain how most careers depend on a basic understanding of the Earth Sciences.	Infer how and in what ways careers depend on the Earth Sciences. 5,3
F. Experimental Situations		
1. Scientific investigations are composed of specific procedures.	Compose exercises which require use of scientific investigation.	Form hypotheses to test results of investigations. 5,10
2. Conclusions can be drawn from scientific investigations.	Describe results of experimental observations.	Interpret data from observations and form conclusions. 5,9

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
III. PHYSICAL SCIENCE (12 weeks)	Students will	
A. Matter and Energy		
1. Matter has two identifying qualities: weight and mass.	Define weight.	Experiment with matter to illustrate weight. *3,12
	Define mass.	Experiment with matter to illustrate mass. 3,12
2. Matter exists in four states: solid, liquid, gas, or plasma.	Identify states of matter.	Observe different states of matter. 1,1
		Experiment with matter to show changes from one state to another. 3,12
3. Common properties of matter are: inertia, mass, weight, density, porosity, and volume.	Create situations to demonstrate common properties of matter.	Experiment with matter and observe common properties. 3,12
4. Special properties of matter are: brittleness, color, elasticity, and odor.	Describe special properties of matter.	Observe matter and classify it by special properties. 2,1
5. All matter is composed of atoms and molecules in different combinations.	Identify molecules and atoms.	Formulate models of atoms and molecules. 3,13

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

SIXTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
6. Atoms are composed of electrons, protons, and neutrons.	Identify particles that compose an atom.	Communicate location of the particles of an atom and their charges. *2,4
7. Radioactive elements give off three kinds of rays: Alpha, Beta, and Gamma.	Describe Alpha, Beta, and Gamma rays.	Communicate the importance of knowing Alpha, Beta, and Gamma rays exist. 6,4
8. Invisible rays can be detected with special equipment.	Discuss how special equipment makes known the presence of charged particles.	Infer importance of detection of charged particles. 5,3
9. Different rays have different penetrating power.	Identify materials necessary to stop Alpha, Beta, and Gamma rays.	Formulate models to block radioactive rays. 3,13
10. Elements are substances composed of only one kind of atom.	Define elements.	Observe pictures of elements. 1,1
11. Compounds are combinations of elements.	List examples of compounds.	Formulate models of atoms that combine to make compounds. 3,13
12. Mixtures are combinations of two or more elements or compounds that retain their unique properties when together.	Describe characteristics of elements, compounds, and mixtures.	Experiment with elements to create compounds and mixtures (solutions). 3,12 Separate and control variables to show relationship among mixtures, compounds, and molecules. 5,11

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CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
13. Chemical changes involve changes in chemical composition of matter.	Understand matter and energy are conserved in chemical reactions.	Formulate experiments to test conservation of matter and energy. *3,13
	Demonstrate rearrangement of matter in chemical reactions.	Observe chemical changes of matter. 2,1
		Infer what happens to atoms in chemical change. 5,3
14. Physical changes involve changes in form.	Demonstrate how form of matter is changed in physical reactions.	Interpret data to determine results of physical changes. 4,9
15. Nuclear changes involve changes in atomic structure of the atoms.	Define fission and fusion.	Formulate models to represent fission and fusion reactions. 3,13
16. Changes in matter require energy.	List types of energy.	Observe different forms of energy. 1,1
	Define conservation of energy.	Observe how one form of energy can be used to produce another form of energy. 1,1
B. Production, Consumption, and Conservation of Energy		
1. Work is done when matter is moved.	Explain Newton's Third Law of Motion.	Formulate experiments to test Newton's Third Law of Motion. 3,13

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SIXTH GRADE

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. Three forms of energy are: light, heat, and sound.	Demonstrate ways to use light, heat, and sound.	Observe ways light, heat, and sound are used. *1,1
3. Alternate energy sources exist and can be used.	Compare effects of alternate energy sources.	Communicate the importance of using alternate energy sources. 6,4
4. Energy can be conserved.	Explore ways to conserve energy.	Infer importance of conserving energy. 5,3
5. Heat energy can be transferred through conductors and can be contained in insulators.	Identify materials which are thermal conductors and insulators.	Classify materials as either conductors or insulators. 3,2
6. Light energy can be bent through a process called refraction.	Identify how light energy can be bent through refraction.	Communicate how light energy can be bent. 3,2
7. Light energy can be cast back from a surface through reflection.	Identify how light energy can be cast back through reflection.	Communicate how light energy can be cast back. 3,4
8. Charges and magnetic poles are associated with electricity.	Explain how to detect electrical charges and magnetic poles.	Observe effects of electrical phenomena. 1,1

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CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
9. An electrical circuit is an unbroken pathway through which electricity flows.	Discuss how electrons flow along a pathway unless interrupted by a special device.	Observe how a switch breaks the flow of electrons. *1,1
10. Electrical circuits can be either series circuits or parallel circuits.	Understand difference between series circuits and parallel circuits.	Construct parallel and series circuits and explain how each operates. 6,14
11. Magnets can be bar magnets, electromagnets, or can occur naturally.	Identify different types of magnets and the special features of each.	Observe special features of different types of magnets. 1,1
C. Contributions of Scientists and Science		
1. Many men and women have contributed to the field of Physical Sciences.	Identify men and women who have contributed to the field of Physical Sciences.	Infer what life might be like without the contributions of scientists to the field of Physical Sciences. 5,3
	Describe what men and women have done in the field of Physical Sciences.	Observe products, inventions, and other findings contributed by men and women in the Physical Sciences. 2,1

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

CONCEPTS TO BE TAUGHT	OBJECTIVES	PROCESS SKILLS
	Students will	
2. An understanding of Physical Science is necessary to function in today's and tomorrow's society.	Appreciate the need for understanding of Physical Science to function successfully in society.	Communicate the need for learning in the Physical Sciences. *6,4
D. Careers in Physical Science		
1. Numerous careers are available for individuals trained in the Physical Sciences.	Identify careers related to understanding of the Physical Sciences.	Communicate careers which depend on understanding of the Physical Sciences. 6,4
2. Many careers depend on a knowledge of the Physical Sciences.	Explain how careers depend on understanding of the Physical Sciences.	Infer how and in what ways careers careers depend on the Physical Sciences. 5,3
F. Experimental Situations		
1. Scientific investigations are composed of specific procedures.	Design and explain scientific investigations using correct procedures.	Form hypotheses to test results of investigations. 5,10
2. Conclusions can be drawn from scientific investigations.	Describe and record results of experimental observations.	Interpret data from recorded results of observations and form conclusions. 5,9

*The first number refers to the Cognitive Level, the second to the Process Skill being emphasized.

THE SECONDARY SCIENCE PROGRAM

The secondary science curriculum presented in the following section of this document offers the basic courses for the continuation of science as introduced and presented in the elementary grades. Beyond these basic areas of study are courses recommended for the development of critical thinking and problem-solving skills necessary for the high technological future today's students will experience. Emphasis is placed on the learning of science by involving students with "hands-on" and laboratory exercises. In addition to the standard courses offered in the secondary curriculum, there are course descriptions for studies in a variety of more specialized fields.

Courses in the secondary curriculum are designed on a two-semester format. Recommended time allotments for each course should be followed to ensure uniformity of the curriculum.

The use of this course of study provides minimum requirements for the teaching of science. Additional course outlines will offer opportunities for maximum development of the higher achievers.

SEVENTH GRADE LIFE SCIENCE

The seventh grade life science course is the first specialization in the science area that students have since entering school. Thus, students are presented with a more detailed account of the living world around them. Opportunities exist for teachers to incorporate a variety of "hands-on" experiences and basic laboratory activities to motivate and stimulate students' learning.

The intent and purpose of this course is to provide:

(1) A basic understanding of the living world,

(2) A foundation for Biology and other life science courses, and

(3) Knowledge that will aid in the decision-making process for wise and efficient use and protection of the world in which we live.

SEVENTH GRADE LIFE SCIENCE

SUGGESTED TIME FRAME		
4 weeks	I.	BASIC SKILLS FOR STUDYING LIFE SCIENCE
		A. Scientific Method
		B. Tools of Investigation 1. Metric system 2. Interpreting data 3. Laboratory equipment
2 weeks	II.	INTRODUCTION TO LIVING THINGS
		A. Living versus Nonliving
		B. The Cell 1. Structure 2. Functions
16 weeks	III.	ORGANIZATION OF LIVING THINGS
(2 weeks)		A. Taxonomy/Classification System
(2 weeks)		B. Viruses, Bacteria, Protists, and Fungi
(6 weeks)		C. Plant Phyla 1. Structure 2. Function
(6 weeks)		D. Animal Phyla 1. Structure 2. Function
2 weeks	IV.	MODIFICATIONS IN LIVING THINGS
		A. Evidences of Change
		B. Possible Causes
6 weeks	V.	HUMAN BIOLOGY
		A. Major Systems 1. Structure 2. Function
		B. Heredity

SEVENTH GRADE LIFE SCIENCE

SUGGESTED
TIME FRAME

6 weeks

VI. ECOLOGY AND THE ENVIRONMENT

A. Biomes

B. Principles of Ecology
1. Inorganic cycles
2. Interdependence among plants and animals
3. Effects of human influence on environment
4. Preservation of environments

SEVENTH GRADE LIFE SCIENCE

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
I. BASIC SKILLS FOR STUDYING LIFE SCIENCE (4 weeks)	Students will:
A. Scientific Method	- Demonstrate understanding of scientific method by using it to solve a scientific problem.
B. Tools of Investigation	
1. Metric system	- Measure using metric units. - Convert metric units to other metric units.
2. Interpreting data	- Construct and interpret charts, tables, and graphs. - Predict data using charts, tables, and graphs.
3. Laboratory equipment	- Identify and explain functions of various laboratory equipment. - Identify parts and explain functions of a microscope. - State laboratory safety rules.
II. INTRODUCTION TO LIVING THINGS (2 weeks)	
A. Living vs Nonliving	- Compare and contrast characteristics of living and nonliving things.
B. The Cell	
1. Structure	- Observe and identify plant and animal cell structures.
2. Function	- State and observe functions of plant and animal cell structures (e.g., osmosis, diffusion, respiration, mitosis, etc.).
III. ORGANIZATION OF LIVING THINGS (16 weeks)	
A. Taxonomy/Classification System (2 weeks)	- Discuss principles of the classification system. - Classify organisms by kingdoms. - State significance of genus and species in nomenclature.

SEVENTH GRADE LIFE SCIENCE

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
B. Viruses, Bacteria, Protists and Fungi (2 weeks)	- Describe characteristics of virus, bacteria, protists, and fungi. - Relate functions of virus, bacteria, protists, and fungi within the organic community.
C. Plant Phyla (6 weeks) 1. Structure	- Observe and identify major structures of the plant kingdom. - Dissect a plant and observe its structures. - Compare and contrast vascular and non-vascular plants. - Compare and contrast gymnosperm and angiosperm. - Compare and contrast dicotyledon and monocotyledon.
2. Function	- Relate individual plant structures to their functions. - Explain functions of plants to the environment. - Observe functions of plants (e.g., photosynthesis, transpiration, etc.).
D. Animal Phyla (6 weeks) 1. Structure	- Compare and contrast animal phyla according to their structural characteristics. - Compare and contrast classes of arthropods and mammals according to their structural characteristics. - Identify major systems of animals. - Dissect a preserved invertebrate animal and observe its structures.
2. Function	- Describe functions of animal systems. - Relate variation in structure to comparative function (e.g., gills and lungs - respiration). - Observe common animal functions (e.g., respiration, circulation, reflex).

SEVENTH GRADE LIFE SCIENCE

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
IV. MODIFICATIONS OF LIVING THINGS (2 weeks)	
A. Evidences of Change	- Relate evidence of change in organisms from past to present.
B. Possible Causes	- Explain possible causes for diversity and adaptation.
V. HUMAN BIOLOGY (6 weeks)	
A. Major Systems 1. Structure	- Identify major organs of each system. - Observe human body structures (e.g., muscles, bones, eye, etc.).
2. Function	- Describe functions of each system. - Observe human system functions (e.g., reflex, reaction, muscle contraction).
B. Heredity	- Explain steps of meiosis. - Relate Mendel's Laws to heredity. - Apply the law of dominance to plant and animal characteristics.
VI. ECOLOGY AND THE ENVIRONMENT (6 weeks)	
A. Biomes	- Describe the world's biomes. - Discuss representative plants and animals found in each biome.
B. Principles of Ecology 1. Inorganic cycles	- Describe and explain inorganic cycles (e.g., water, oxygen, nitrogen, etc.).
2. Interdependence of organisms	- Explain significance of the interdependence of organisms.
3. Influence of human behavior on environment	- Observe environmental effects of human behavior (e.g., pollution, land development, human population demands).

SEVENTH GRADE LIFE SCIENCE

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
4. Preservation of environments	Students will: - Predict future environmental changes. - Develop strategies for preservation of the living world. - Demonstrate respect for plants, animals and the environment.

EIGHTH GRADE EARTH AND SPACE SCIENCE

Science for the eighth grade is an introductory and exploratory course in earth and space science. Many areas of earth and space science make up the content, with each area explored sufficiently to enable students to use the knowledge they have gained in interpreting observations and events related to their world.

It should be noted that this information may be the only exposure to knowledge about the earth and our place in the universe that students will receive at the secondary level. With that in mind, teachers should not only be practical in their applications, but realize that activity-based learning is crucial to motivation and interest. Therefore, activities and laboratories fostering this approach are encouraged throughout this content area. Teachers should realize that this course of study encompasses minimum content only. They are encouraged to develop and add to what is included in this document.

EIGHTH GRADE EARTH AND SPACE SCIENCE

SUGGESTED TIME FRAME		
2 weeks	I.	INTRODUCTION
		A. Scientific Investigation
		B. Scientific Skills
		C. Metric System
		D. Career Opportunities in Science
		E. Laboratory Safety
5 weeks	II.	THE UNIVERSE OVERVIEW
		A. Matter and Properties
		B. Energy 1. Electromagnetic waves 2. Transfer of energy
		C. Galaxies
		D. Methods of Investigations
		E. Theories of Formation
2 weeks	III.	STARS
		A. Structure
		B. Constellations
4 weeks	IV.	OUR SOLAR SYSTEM
		A. The Sun
		B. The Planets
		C. The Moon 1. Structure 2. Phases
3 weeks	V.	SPACE INVESTIGATION
		A. Unmanned
		B. Manned

EIGHTH GRADE EARTH AND SPACE SCIENCE

SUGGESTED TIME FRAME		
5 weeks	VI.	EARTH
		A. Lithosphere
		1. Rocks and minerals
		2. Internal structure and earthquakes
		3. Mountains, crustal movement, and volcanoes
		4. Radioactive dating
		5. Fossils
		6. Land formation
		7. Weathering
3 weeks		B. Hydrosphere
3 weeks		C. Atmosphere
		1. Composition
		2. Global winds
		3. Coriolis effect
3 weeks		D. Meteorology
		1. Weather
		2. Climate
2 weeks		E. Natural Resources
		1. Renewable
		2. Nonrenewable
2 weeks		F. Global Location
		1. Mapping
		2. Time determination
2 weeks	VII.	CURRENT TRENDS IN EARTH AND SPACE SCIENCE
		A. Ecology and Pollution
		B. Nuclear Energy

EIGHTH GRADE EARTH AND SPACE SCIENCE

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
I. INTRODUCTION (2 weeks)	Students will:
A. Scientific Investigation vs Application	- Draw conclusion from inclusive evidence and experience.
B. Scientific Skill	- Solve problems using organized data.
C. Metric System	- Measure using metric units. - Convert metric units to other metric units.
D. Career Opportunities	- Differentiate betweeen careers that are purely scientific and purely technological. - Classify scientists according to their areas of study. - Discuss scientific professions and prerequisites of each.
E. Laboratory Safety	- Establish and review laboratory safety rules and procedures.
II. THE UNIVERSE OVERVIEW (5 weeks)	
A. Matter and Properties	- Define matter, states of matter. - Identify characteristics of matter. - Observe and measure matter in different states. - Define atom, element. - Describe a model of an atom. - Explain crystal formations. - Read and explain the periodic chart. - Demonstrate how molecules can be formed and broken. - Discuss law of gravity.
B. Energy 1. Electromagnetic waves	- Name the types of electromagnetic radiation. - Interpret the electromagnetic radiation spectrum and frequencies. - Explain quasar and pulsar. - Demonstrate the Doppler effect.

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
2. Transfer of Energy	- Define energy. - Demonstrate energy forms and energy transformation. - Relate the use of energy to its form. - Discuss solar and nuclear energy.
C. Galaxies	- Explain the characteristics of the Milky Way Galaxy. - Recognize types of galaxies. - Describe evidence of changes in the galaxy. - Illustrate a top view and side view of the galaxy. - Locate the solar system on a top or side view of the galaxy.
D. Methods of Investigation	- Recognize designs of astronomical instruments. - Discuss use of astronomical instruments. - Compare and contrast the refracting and reflecting telescope. - Explain how spectroscopes are used. - Discuss radio telescopes, optical and nonoptical telescopes. - Explain the use of observatories.
E. Theories of Formation	- Define theories. - Discuss and give evidence to support these theories.
III. STARS (2 weeks)	
A. Structure	- Discuss structure of stars. - Explain life cycle of stars. - Describe Hertzsprung Russell diagram. - Explain the relationship of stars' brightness to temperature.
B. Constellations	- Explain how constellations are named. - Identify constellations.

EIGHTH GRADE EARTH AND SPACE SCIENCE

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
IV. OUR SOLAR SYSTEM (4 weeks)	- Describe the solar system.
A. The Sun	- Describe major features of the sun. - Relate distance between the planets and the sun's energy. - Explain source of the sun's energy.
B. The Planets	- Identify the planets. - Explain organizational pattern of the planets in the solar system. - Describe features of each planet. - State Kepler's three laws. - Describe the protoplanet model.
C. The Moon 1. Structure	- Describe the surface of the moon. - Describe forces that change the surface of the moon.
2. Phases	- Discuss four phases of the moon. - Relate position of the moon, sun, and earth to tides. - Describe the processes of eclipses.
V. SPACE INVESTIGATIONS (3 weeks)	
A. Unmanned	- Explain use of satellite feedback. - Interpret and predict use of space observatories. - Name some unmanned space missions.
B. Manned	- Survey the scope of manned expeditions. - Compare and contrast manned expeditions vs unmanned expeditions. - Discuss accomplishments in space. - Name some of the astronaunts. - Discuss difficulties experienced in space.

EIGHTH GRADE EARTH AND SPACE SCIENCE

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
VI. EARTH (5 weeks)	
A. Lithosphere	- Define lithosphere, minerals.
1. Rock and minerals	- Describe processes that form rocks. - Identify major kinds of igneous, sedimentary, and metamorphic rocks. - Explain the rock cycle. - Explain uses of the three major kinds of rocks. - Discuss physical properties of minerals. - Compare and contrast rocks and minerals. - Explain how to identify a mineral.
2. Internal structure and earthquakes	- Name and describe characteristics of three major parts of the earth. - Diagram the earth's interior. - Explain how astronomy provides indirect evidence about the earth's interior. - Identify major causes of earthquakes. - Tell what instrument is used to measure an earthquake. - Explain three types of seismic waves.
3. Mountain, crustal movement, and volcanoes	- Define mountain range. - Define fault, folding. - Discuss types of faults. - Identify two major types of folds. - Define volcano. - Generalize how volcanic mountains are made. - Describe geologic features produced by magma in crust. - Demonstrate formation of a volcano. - Discuss volcanoes that have erupted.
4. Radioactive dating	- Explain how radioactive dating is used to estimate the age of the earth.
5. Fossils	- Define fossil. - Explain how fossils are formed. - Describe the natural method of fossil formation. - Discuss fossil fuels. - Interpret geologic time scale.

EIGHTH GRADE EARTH AND SPACE SCIENCE

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
6. Land formation	- Define landforms. - Name major way landforms are constructed. - Interpret geologic features as they appear on a topographic map. - Name major landforms.
7. Weathering	- Define weathering. - Describe three major weathering processes. - Discuss erosion. - Explain the role of gravity in moving earth material downhill. - Discuss landscape features shaped primarily by running water, glaciers and wind.
B. Hydrosphere (3 weeks)	- Discuss major ocean currents. - Outline five major cells of ocean circulation. - Discuss percentages of salt and fresh water.
C. Atmosphere (3 weeks)	
1. Composition	- Name four major gases of the atmosphere. - Explain how atmospheric pressure is measured. - Use a barometer.
2. Global winds	- Explain what makes wind blow. - Describe convection current. - Demonstrate the convection cell. - Draw a model of the global winds.
3. Coriolis effect	- Explain the coriolis effect. - Describe large scale air movements for the whole earth.
D. Meteorology (3 weeks)	
1. Weather	- Define weather. - Discuss how weather is predicted. - Illustrate how instruments are used for measuring weather. - Differentiate between weather and climate.

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
2. Climate	- Explain how location determines climate. - Explain how solar energy determines global groups of climates. - Explain major groups of climates based on temperatures.
E. Natural Resources (2 weeks)	
1. Renewable	- Discuss natural resources. - Identify some renewable resources. - Explain uses of minerals and ores.
2. Nonrenewable	- Define nonrenewable resources.
F. Global Location (2 weeks)	
1. Mapping	- Demonstrate longitude and latitude on a map.
2. Time determination	- Describe how time zones are determined.
VII. CURRENT TRENDS IN EARTH AND SPACE SCIENCE (2 weeks)	
A. Concerns for Life	- Describe various kinds of pollution. - Discuss prevention of pollution. - Research changes that have occurred in the environment.
B. Nuclear Energy	- Discuss role of nuclear energy in today's world. - Research changes that have occurred as a result of nuclear energy. - Demonstrate use of nuclear energy.

PHYSICAL SCIENCE

Physical Science is a survey course of the concepts taught in Chemistry and Physics. This course is offered in grades 9-12 and can be used to satisfy the physical science unit required by the State of Alabama for graduation. This course, along with Biology, Chemistry, and Physics, provides a comprehensive science program for secondary students.

The concepts taught in physical science are not covered in the same depth as in the other courses; however, they are expanded from those taught in the elementary grades. Emphasis is placed on matter, mechanics, heat, energy, light, magnetism, electricity, and chemistry. Laboratory experiences should be provided for the reinforcement of concepts and for enrichment.

Physical Science encompasses a number of science disciplines; therefore, a more detailed course outline has been provided. This course has been divided into a first and a second semester with specific topics to be taught each semester. The topics outlined should be covered within the recommended semester, regardless of the format of the textbook being used-thus providing consistency across the state.

Additional learning activities are strongly encouraged. Teachers are not limited to the activities inferred in this course of study. Students should be encouraged to explore natural phenomena and to pursue individual interests.

PHYSICAL SCIENCE

FIRST SEMESTER

SUGGESTED TIME FRAME		
2 weeks	I.	INTRODUCTION TO PHYSICAL SCIENCE
		A. Relationship between Science and Technology
		B. Methods of Science 1. Using experiments 2. Theories and laws
		C. Laboratory Safety
		D. Accuracy of Measurement
		E. Scientific Notation
		F. Metric System
		G. Graphing
6 weeks	II.	MECHANICS
		A. Force
		B. Work
		C. Energy
		D. Power
		E. Machines 1. Functions 2. Types 3. Mechanical advantage 4. Efficiency
		F. Motion 1. Forces and motion 2. Velocity and acceleration 3. Newton's laws of motion 4. Forces in solids, liquids, and gases a. Cohesion and adhesion b. Fluid pressure c. Pascal's Law d. Archimede's Principle

PHYSICAL SCIENCE

FIRST SEMESTER

SUGGESTED TIME FRAME		
3 weeks	III.	HEAT
		A. The Nature of Heat
		B. Measurement of Heat and Temperature
		C. Heat Transfer
		D. Changes of State
		E. Expansion and Contraction
		F. Heating and Cooling Systems
		G. Thermal Pollution
3 weeks	IV.	LIGHT
		A. Nature of Light
		B. Light Waves 1. Characteristics 2. Properties 3. Reflection and refraction 4. Electromagnetic radiation
		C. Light and Color
		D. Lenses and Vision
2 weeks	V.	SOUND AND WAVES
		A. Nature of Sound
		B. Characteristics of Sound
		C. Sound Phenomena
		D. Musical Sounds and Instruments
		E. Noise Pollution

PHYSICAL SCIENCE

FIRST SEMESTER

SUGGESTED
TIME FRAME

2 weeks

VI. MAGNETISM

A. Nature of Magnetism

B. Types of Magnets

C. Uses of Magnets

D. Magnetic Fields and Lines of Forces

PHYSICAL SCIENCE

SECOND SEMESTER

SUGGESTED
TIME FRAME

3 weeks

VII. ELECTRICITY

- A. Kinds of Charges
- B. Static Electricity
- C. Conductors and Nonconductors
- D. Current Electricity
  1. Series and parallel circuits
  2. Measuring electricity
  3. Controlling electric currents

2 weeks

VIII. MATTER

- A. Characteristics
- B. States of Matter
- C. Mixtures
  1. Homogeneous
  2. Heterogeneous
- D. Properties of Matter
  1. Physical
  2. Chemical
- F. Elements

2 weeks

IX. THE ATOM

- A. Atomic Structure
  1. Development of knowledge
  2. General structure
  3. Electron configuration
- B. Isotopes

PHYSICAL SCIENCE

SECOND SEMESTER

SUGGESTED
TIME FRAME

8 weeks

X. CHEMISTRY

A. Periodic Table of Elements

B. Families of Elements
   1. Metals
   2. Nonmetals

C. Compounds and Mixtures

D. Bonding and Valence of Oxidation
   1. Electron transfer
   2. Electron sharing
   3. Oxidation number

E. Chemical Shorthand
   1. Symbols
   2. Formulas
   3. Equations

F. Chemical Reactions
   1. Balancing equations
   2. Types of reactions
      a. Synthesis
      b. Decomposition
      c. Single replacement
      d. Double replacement

G. Chemical Compounds
   1. Acids
   2. Bases
   3. Salts

H. Solutions
   1. Nature and type
   2. Rate of solution
   3. Solubility
   4. Particles in a solution

3 weeks

XI. ENERGY

A. Sources
   1. Renewable
   2. Nonrenewable

B. Conservation

PHYSICAL SCIENCE

SECOND SEMESTER

XI. ENERGY (continued)

C. Nuclear Energy
   1. Development of knowledge of radiation
   2. Causes of natural radiation
   3. Types of radiation
   4. Detection and measurement
   5. Nuclear fission and fusion
   6. Nuclear reactors
   7. Protection from radiation
   8. Useful application of radioactive isotopes

D. Alternatives
   1. Solar
   2. Wind
   3. Geothermal
   4. Tidal
   5. Biomass

PHYSICAL SCIENCE
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
I. INTRODUCTION TO PHYSICAL SCIENCE (2 weeks)	Students will:
A. Relationship between science and technology	- Identify some ways science and technology are related and are used in our daily lives.
B. Methods of Science	
1. Using experiments	- Interpret the design of an experiment. - Analyze data from experiments.
2. Theories and laws	- Differentiate between a theory and a law and explain how they are formed.
C. Laboratory Safety	- Establish and review laboratory safety rules and procedures.
D. Accuracy of Measurement	- Use metric units for measuring mass, volume, and length. - Identify reasons measurements must be accurate in experiments.
E. Scientific Notation	- Perform calculations using scientific notation.
F. Metric System	- Identify metric units used to measure volume, length, and weight and make metric conversions.
G. Graphing	- Construct and interpret graphs.
II. MECHANICS (6 weeks)	
A. Force	- Define force, work, power and energy; explain their similarities and differences.
B. Work	- Solve appropriate problems.
C. Energy	- Define kinetic and potential energy and give examples of each.
D. Power	- Solve appropriate problems.
E. Machines	
1. Functions	- Describe three ways machines help man.
2. Types	- Distinguish between simple and compound machines.

PHYSICAL SCIENCE
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
E. Machines (continued)	
3. Mechanical advantage	- Calculate the mechanical advantage of simple machines.
4. Efficiency	- Perform calculations to determine the efficiency of machines.
F. Motion	
1. Forces and motion	- Show the relationship of force and motion and identify some types of forces.
2. Velocity and acceleration	- Distinguish between velocity and acceleration.
3. Newton's laws of motion	- Demonstrate the relationship between motion and force in Newton's three laws.
4. Forces in solids, liquids, and gases	
a. Cohesion & adhesion	- Distinguish between cohesion and adhesion.
b. Fluid pressure	- Explain how forces are transferred within liquids.
c. Pascal's Law	- Apply Pascal's law to describe how pressure in confined gases is distributed.
d. Archimede's Principle	- Use the principle to explain bouyancy and why objects float.
III. HEAT (3 weeks)	
A. The Nature of Heat	- Describe the relationship between heat and temperature.
B. Measurement of Heat and Temperature	- Describe how temperature is measured.
C. Heat Transfer	- Describe heat movement by conduction, convection, and radiation.
D. Changes of State	- Explain how heat causes matter to change state.
E. Expansion and Contraction	- Demonstrate what happens to matter when it is heated or cooled.

PHYSICAL SCIENCE
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
F. Heating & Cooling Systems	- Contrast various heating systems. - Describe various cooling systems and explain the role of evaporation.
G. Thermal Pollution	- Explain the problem of thermal pollution.
IV. LIGHT (3 weeks)	
A. Nature of Light	- Explain the importance of light and give the composition of light.
B. Light Waves	
1. Characteristics	- Describe two characteristics of light waves.
2. Properties	- Define amplitude, frequency, velocity, and wave length.
3. Reflection and refraction	- Distinguish between reflection and refraction.
4. Electromagnetic radiation	- Identify the colors in a magnetic spectrum and indicate which colors have the longest and shortest light waves.
C. Light and Color	- Identify the three primary pigment colors and the primary light colors.
D. Lenses and Vision	- Name the two kinds of lenses and explain how they are different. - Describe the type of lenses used to correct farsightedness and nearsightedness.
V. SOUND AND WAVES (2 weeks)	
A. Nature of Sound	- Discover how sounds are produced and transmitted.
B. Characteristics of Sound	- Describe the relationship between pitch and frequency; amplitude and sound volume.
C. Sound Phenomena	- Give one practical application for the following: the Doppler effect, sound to acoustics, and ultrasonics.

PHYSICAL SCIENCE
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
D. Musical Sounds and Instruments	- Explain how musical sounds are produced by strings, woodwinds, brass, and percussions.
E. Noise Pollution	- Describe some examples of noise pollution and suggest methods for controlling this type of pollution.
VI. MAGNETISM (2 weeks)	
A. Nature of Magnetism	- Describe the behavior of magnets.
B. Types of Magnets	- Name the two types of magnets and give examples of each.
C. Uses of Magnets	- Explain how electromagnets are used in motors, bells, and other electrical devices.
D. Magnetic Fields and Lines of Forces	- Demonstrate the action of magnetic fields and poles.

PHYSICAL SCIENCE
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
VII. ELECTRICITY (3 weeks)	Students will:
A. Kinds of Charges	- Describe various methods for obtaining and identifying electrical charges.
B. Static Electricity	- Define static electricity and list practical application.
C. Conductors & Nonconductors	- Differentiate between conductors and nonconductors and give practical application for each.
D. Current Electricity	
1. Series and parallel circuits	- Compare parallel and series circuits; build several circuits and diagram others.
2. Measuring electricity	- Demonstrate ability to read selected electrical measuring instruments.
3. Controlling electric currents	- Describe the advantages of direct circuits over alternating currents.
VIII. MATTER (2 weeks)	
A. Characteristics	- Identify some characteristics of matter.
B. States of Matter	- Describe four states of matter.
C. Mixture	
1. Homogeneous	- Discuss the difference between homogeneous and heterogeneous mixtures.
2. Heterogeneous	- Differentiate among substances to determine whether they are heterogeneous or homogeneous.
D. Properties of Matter	- Describe some physical and chemical properties of matter.
E. Changes in Matter	
1. Physical	- Compare and differentiate between physical and chemical changes.
2. Chemical	- Conduct activities to demonstrate chemical and physical changes.
F. Elements	- Define an element and give symbols for some common elements.

PHYSICAL SCIENCE
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
IX. THE ATOM (2 weeks)	Students will:
A. Atomic Structure	
1. Development of knowledge	- Identify contributions of early scientists to the development of the atomic theory.
2. General structure	- Describe the basic part of an atom.
3. Electron configuration	- Demonstrate an understanding of atomic structure by drawing the electron configuration of elements in the first two periods on the periodic table.
B. Isotopes	- Recognize isotopes of elements.
X. CHEMISTRY (8 weeks)	
A. Periodic Table of Elements	- Identify the various families of elements and locate them on the periodic table.
B. Families of Elements	
1. Metals	- Explain what happens to metallic character of elements from left to right on the periodic table.
2. Nonmetals	- Identify metals and nonmetals from the periodic table.
C. Compounds and Mixtures	- Identify some common compounds and mixtures; contrast the properties of each.
D. Bonding and Valence of Oxidation	
1. Electron transfer	- Distinguish between covalent and ionic bonding.
2. Electron sharing	- Describe how electrons are shared.
3. Oxidation number	- Use oxidation numbers to write formulas for compounds.
E. Chemical Shorthand	
1. Symbols	- Correctly identify elements by their symbols.
2. Formulas	- Write formulas for simple compounds from their names.
3. Equations	- Write simple equations.

PHYSICAL SCIENCE
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
F. Chemical Reactions	
1. Balance equations	- Balance equations.
2. Types of reactions	
a. Synthesis	- Differentiate between the following reactions: synthesis and decomposition; single replacement and double replacement.
b. Decomposition	
c. Single replacement	
d. Double replacement	- Recognize types of reactions.
G. Chemical Compounds	
1. Acids	- Contrast the properties of acids and bases.
2. Bases	- Determine what is acidic or basic by using indicators.
3. Salts	- Describe a neutralization reaction.
H. Solutions	
1. Nature and type	- Contrast the properties of various solutions.
2. Rate of solution	- Identify factors which affect the rate of solutions.
3. Solubility	- Describe the properties of a solution
4. Particles in a solution	- Identify the parts of a solution.
XI. ENERGY (3 weeks)	
A. Sources	
1. Renewable	- Name the fossil fuels and relate why there is a shortage.
2. Nonrenewable	- Identify some nonrenewable sources of energy.
B. Conservation	- Describe ways to conserve energy.
C. Nuclear Energy	
1. Development of knowledge of radiation	- Discuss contributions of scientists to the development of knowledge about radiation.
2. Causes of natural radiation	- List the causes of natural radiation and describe how radiation affects the body.
3. Types of radiation	- Identify the types of radiation.
4. Detection and measurement	- Describe methods used to detect and measure radiation.

PHYSICAL SCIENCE
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
C. Nuclear Energy (continued)	
5. Nuclear fission and fusion	- Distinguish between nuclear fission and nuclear fusion.
6. Nuclear reactors	- Describe ways nuclear reactors are used today.
7. Protection and radiation	- Discuss some methods used for protection against radiation.
8. Useful application of radioactive isotopes	- Identify some ways radioactive isotopes are used in medicine, research, and industry.
D. Alternatives	
1. Solar	- Describe some ways solar energy is used.
2. Wind	- Describe how the sun, wind, tides, and biomass are used as energy alternatives.
3. Geothermal	- Explain the advantages of using energy alternatives.
4. Tidal	
5. Biomass	

BIOLOGY

In schools where the student population permits, the curriculum should include two levels of Biology. Both Basic Biology and College Preparatory Biology should be offered. In either course, a laboratory-oriented classroom is highly recommended. If instruction follows this approach, students learn through activities which permit them to touch and experience a world of plants and animals that may have been unavailable previously.

Course outlines and instructional objectives for both Basic Biology and College Preparatory Biology are included in this course of study.

BASIC BIOLOGY

Basic biology provides students with general exploratory experiences and activities in the fundamental concepts of life and expands the biological concepts that were introduced in elementary and junior high/middle school in addition to presenting additional facts, concepts, and generalizations. This course is not a prerequisite for college preparatory biology. Students having earned a unit of college preparatory biology cannot take this course.

FIRST SEMESTER

SUGGESTED TIME FRAME		
3 weeks	I.	INTRODUCTION TO BIOLOGY
		A. Study of Life
		B. Laboratory Safety
		C. Features of Life
		D. Classification
		E. Kingdoms 1. Monera 2. Protista 3. Fungi 4. Plants 5. Animals
7 weeks	II.	PLANTS
		A. Types of Plants
		B. Structures and Functions of Plants
		C. Reproduction
		D. Behavior
8 weeks	III.	ANIMALS
		A. Invertebrates
		B. Vertebrates

BASIC BIOLOGY

SECOND SEMESTER

SUGGESTED
TIME FRAME

11 weeks

IV. HUMAN BIOLOGY

A. Maintaining Life
   1. Skeletal and muscular systems
   2. Circulation and blood
   3. Respiration and excretion
   4. Nutrition and digestion

B. Controlling Life
   1. Nervous and endocrine systems
   2. Senses
   3. Behavior
   4. Alcohol and drugs

C. Continuing Life
   1. Reproduction and development
   2. Genetics

2 weeks

V. EVOLUTIONARY PROCESSES

A. Specie Modification

B. Environmental Factors

C. Scientific Theories of Origin and Evolution

5 weeks

VI. ECOLOGY

A. Populations

B. Ecosystems

C. Present Ecological Problems

BASIC BIOLOGY
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
I. INTRODUCTION TO BIOLOGY (3 weeks)	Students will:
A. Study of Life	- Identify professions that utilize biological skills and knowledge. - Name the parts of a compound microscope, explain how it works. - Name and define steps of the scientific method. - Use metric (SI) units for length, volume, and temperature.
B. Laboratory Safety	- Establish and review laboratory safety rules and procedures.
C. Features of Life	- Identify characteristics of life. - Contrast living and nonliving things. - Compare plant and animal cells. - Identify cell parts and functions. - Demonstrate processes of diffusion and osmosis. - Describe the levels of organization from simple to complex (cell, tissue, organ, organ systems, organism).
D. Classification	- Recognize the grouping of objects in everyday life. - Discuss reasons for classifying. - Identify problems involved in classification. - Describe how Linnaeus classified life forms. - Name the groupings in Linnaeus system.
E. Kingdoms	- Describe each of the five kingdoms of the classification system and identify the characteristics of each.
II. PLANTS (7 weeks)	
A. Types of Plants	- Identify characteristics of vascular and nonvascular plants. - Identify characteristics of gymnosperms and angiosperms. - Identify characteristics of monocotyledons and dicotyledons. - Describe deciduous and coniferous trees.

BASIC BIOLOGY
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
B. Structures and Functions of Plants	- Describe basic structures and functions of roots and stems. - Describe the structure of leaves. - Describe transpiration. - Identify the steps involved in the process of photosynthesis.
C. Reproduction	- Compare the types of reproduction exhibited by plants. - Describe the conditions necessary for the germination of seeds.
D. Behavior	- Explain the types of tropism.
III. ANIMALS (8 weeks)	
A. Invertebrates	- Describe structure and function of protozoans. - Relate economic importance of protozoans. - Name and describe the invertebrate phyla. - Recognize role of invertebrates as food, competitors for human food, and economic importance. - Identify major anatomical structures found in sponges, jellyfish, worms, mollusks, echinoderms and arthropods. - Describe the life cycles of major parasitic worms. - Analyze how various parasites and vectors of disease may be controlled.
B. Vertebrates	- Identify characteristics of Chordata. - Identify characteristics of vertebrates. - Name and describe major division of Chordata. - Classify representatives into vertebrate classes and orders using taxonomic keys. - Observe progressive development systems in the vertebrate classes. - Describe open and closed circulatory classes.

BASIC BIOLOGY
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
IV. HUMAN BIOLOGY (11 weeks)	Students will:
A. Maintaining Life	
1. Skeletal and muscular systems	- Identify functions of the skeleton. - Describe bone formation and structure. - Locate and label bones. - Name and locate examples of joints. - Compare muscle types. - Describe a muscle contraction. - Give examples of muscles working in pairs. - Discuss muscular and skeletal disorders.
2. Circulation and blood	- Identify parts of the heart. - Name and describe valves in the heart. - Place in order the events or steps as blood passes through the heart. - Describe the flow of blood through the body. - Contrast features of arteries, veins, and capillaries. - Identify functions of blood. - Identify blood types and factors. - Discuss transfusion. - Identify some cardiovascular diseases. - Describe the immune system.
3. Respiration and excretion	- Name organs of respiration. - Describe the mechanics of breathing. - Describe how carbon monoxide can be harmful. - Identify some respiratory diseases and possible causes. - Name organs of excretion. - Describe the main parts and functions of human skin. - Describe the events occurring in nephron. - Identify the organs in human urinary tract.
4. Nutrition and digestion	- Contrast nutrients and nutrition. - Match foods to their contents (carbohydrates, fats, and/or proteins). - Compare body requirements of carbohydrates, fats, and proteins.

BASIC BIOLOGY
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
4. Nutrition and digestion (continued)	- Determine which foods contain starch, sugars, fats, and proteins. - Name some vitamins and why they are needed. - Determine nutrient content of food labels. - Identify the need for water in the body. - Describe a balanced meal. - Define calorie. - Explain how calories taken into the body are related to increased or decreased weight. - Name the organs of the alimentary tract. - Contrast physical and chemical digestion. - Describe the function of accessory digestive organs. - Discuss the role of enzymes in nutrition. - Identify where nutrients are digested. - Discuss surface area in relation to absorption.
B. Controlling Life	
1. Nervous and endocrine systems	- Describe events taking place in a nerve responding to a stimulus. - Draw and label a neuron. - Explain how impulses travel from one nerve cell to another. - Describe a reflex action. - Identify the main regions of the brain. - Name the major endocrine glands, the hormones produced, and the bodily processes each controls. - Contrast the way "messages" move in the nervous system with the endocrine system. - Identify endocrine disorders. - Describe the role of insulin and the symptoms for diabetes.
2. Senses	- Identify the parts of the ear and explain how the ear works. - Describe temporary and permanent hearing impairment. - Identify major parts of the eye.

BASIC BIOLOGY
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
2. Senses (continued)	- Describe some common eye defects. - Describe the four taste areas on the tongue. - Identify the parts of the nose and explain how odors are detected. - Describe sensations detected by the skin.
3. Behavior	- Define stimulus, response. - Describe innate behavior. - Identify examples of learned behavior. - Analyze the behaviors involving food-getting, protection, reproduction, care of the young, migration.
4. Alcohol and drugs	- Describe harmful effects of drugs and alcohol.
C. Continuing Life	
1. Reproduction and development	- Compare and contrast mitosis and meiosis. - Identify the organs of the male and female reproductive systems. - Describe the major events of menstruation. - Describe the formation of gametes and the fertilization process. - Describe human egg cleavage. - Describe fetal development. - Identify the types of birth. - Explain the functions of the uterus and placenta.
2. Genetics	- Describe the function and structure of DNA. - Compare male and female sex chromosomes. - Apply Mendel's Laws to human genetics. - Discuss examples of mutation. - Use a punnett square to solve genetic problems. - Describe the transmission of sex-linked traits. - Describe gene and chromosomal disorders.

BASIC BIOLOGY
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
V. EVOLUTIONARY PROCESSES (2 weeks)	Students will:
A. Specie Modification	- Identify evidences of changes in plants and animals. - Discuss the development of embryology comparing several vertebrates. - Identify some vestigal structures. - Discuss possible causes of variation. - Describe causes of mutation. - Identify the significance of evolving forms. - Discuss fossils and fossil histories.
B. Environmental Factors	- Describe long-term climatic changes. - Identify past changes in land forms. - Discuss changing life support systems.
C. Scientific Theories of Origin and Evolution	- Discuss possible hypotheses to explain evolutionary changes. - Describe Darwin's Theory of Evolution. - Discuss conflicting theories of evolutionary changes.
VI. ECOLOGY (5 weeks)	
A. Populations	- Contrast producer and consumer. - Distinguish between ecology and an ecosystem. - Compare primary and secondary consumers. - Identify predators and prey relationships. - Describe a food chain and food web. - Give examples of parasitism, commensalism, and mutualism. - Explain how organisms depend on each other. - Graph population changes due to increase or decrease of food, shelter, and water.

BASIC BIOLOGY
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
B. Ecosystems	- Explain the nitrogen cycle. - Explain the water, carbon dioxide, and oxygen cycles. - Describe formation and recycling of nitrates. - Trace steps of succession in land communities. - Identify examples of biomes. - Explain factors that determine the climate of an area.
Present Ecological Problems	- Identify causes of animals and plants becoming rare or endangered. - Identify major kinds and sources of pollution. - Identify ways the soil can become polluted. - Describe major sources of water and air pollution. - Explain causes of acid rain. - Describe health problems resulting from various types of pollution. - Trace PCB buildup in organisms back to the possible source. - Identify possible alternatives to pesticide usage. - Describe man's responsibilities and challenges for maintaining our world.

COLLEGE PREPARATORY BIOLOGY

College Preparatory Biology is designed to provide students with exploratory experiences and activities in preparation for college biology. Basic biology is not a prerequisite for this course.

FIRST SEMESTER

SUGGESTED TIME FRAME		
5 weeks	I.	NATURE OF LIFE
		A. Characteristics of Life
		B. Biology as a Science
		C. Chemistry of Life
		D. Cell Structure and Function
		E. Energy of Life
4 weeks	II.	CONTINUITY OF LIFE
		A. DNA and Cell Reproduction
		B. Genetics
		C. Classification of Life
		D. Specie Modification
		E. Scientific Theories of Origin and Evolution
3 weeks	III.	MICROBIOLOGY
		A. Monerans and Protists
		B. Fungi and Viruses
3 weeks	IV.	BOTANY
		A. Nonvascular
		B. Vascular
3 weeks	V.	ECOLOGY

COLLEGE PREPARATORY BIOLOGY

SECOND SEMESTER

SUGGESTED TIME FRAME		
10 weeks	VI.	ZOOLOGY
		A. Invertebrates
		B. Vertebrates
8 weeks	VII.	HUMAN BIOLOGY
		A. Maintaining Life Systems
		B. Controlling Life Systems
		C. Reproduction and Development

COLLEGE PREPARATORY BIOLOGY
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
I. NATURE OF LIFE (5 weeks)	Students will:
A. Characteristics of Life	- Identify and describe characteristics common to all living things. - Distinguish between living and non-living substances. - Identify physical and chemical conditions for life.
B. Biology as a Science	- Illustrate application of the scientific method. - Identify, describe, and apply tools of science. - Describe various fields of biological science and career opportunities in each field. - Establish and review laboratory safety rules and procedures.
C. Chemistry of Life	- Identify and describe atomic structure. - Explain covalent and ionic bonding. - Distinguish among mixture, solutions, suspensions, and colloids. - Explain biosynthesis of carbohydrates, lipids, and proteins. - Explain role of enzymes in cells.
D. Cell Structure and Function	- Label, describe, and give function of cellular organelles. - Explain processes that take place in the cell. - Identify levels of composition from simple to complex.
E. Energy of Life	- Describe process of photosynthesis. - Relate role of ADP and ATP to cellular respiration.
II. CONTINUITY OF LIFE (4 weeks)	
A. DNA and Cell Reproduction	- Recognize importance of protein synthesis. - Describe and identify structure of DNA and RNA. - Describe role of RNA and DNA in protein synthesis.

COLLEGE PREPARATORY BIOLOGY
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
B. Genetics	- Name and describe stages of mitosis. - Name and describe stages of meiosis. - Explain Mendel's Laws of Genetics. - Demonstrate understanding of genotype/phenotype, independent assortment, and incomplete dominance. - Solve genetic problems involving Mendel's Laws.
C. Classification of Life	- Explain need for classification. - Explain and describe bases for scientific classification. - Name grouping in the system of classification.
D. Specie Modification	- Discuss evidence of change through biogeography, comparative anatomy, physiology, embryology, and vestigal structures. - Examine mechanisms of variations by environmental adaptations and mutations.
E. Scientific Theories of Origin and Evolution	- Explain Darwinian Theory. - Discuss alternate theories. - Describe biological principles in the continuity of life.
III. MICROBIOLOGY (3 weeks)	
A. Monerans and Protists	- Distinguish between phylum Schizophyta and Cyanophyta. - Name, describe, and give examples of phyla of Protista.
B. Fungi and Viruses	- Explain why viruses could be considered living or nonliving. - Explain importance of viruses and fungi. - Describe role of microorganisms and diseases.

COLLEGE PREPARATORY BIOLOGY
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
IV. BOTANY (3 weeks)	- Name and describe simple plants. - Describe and identify mosses and ferns. - Describe main characteristics of angiosperms and gymnosperms. - Describe function of specialized plant tissues. - Describe reproductive process in plants.
ECOLOGY (3 weeks)	- Describe ecosystems. - Describe interaction between biotic and physical environment. - Name and describe the major biomes. - Discuss human population growths.

COLLEGE PREPARATORY BIOLOGY
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
VI. ZOOLOGY (10 weeks)	Students will:
A. Invertebrates	- Describe structure and function of protozoans. - Relate economic importance of protozoans. - Name and describe the invertebrate phyla. - Recognize role of invertebrates as food, competitors for human food, and economic importance. - Identify major anatomical structures found in sponges, jellyfish, worms, mollusks, echinoderms and arthropods. - Trace life cycles of major parasitic worms. - Analyze how various parasites and vectors of disease may be controlled.
B. Vertebrates	- Identify characteristics of Chordata. - Identify characteristics of vertebrates. - Name and describe major division of Chordata. - Classify representatives into vertebrate classes and orders using taxonomic keys. - Observe progressive development systems in the vertebrate classes. - Distinguish between innate and learned behaviors.
VII. HUMAN BIOLOGY (8 weeks)	
A. Maintaining Life Systems	- Identify major organs and functions of digestion. - Locate and label major blood vessels. - Identify components of blood samples. - Identify functions of plasma, red and white blood cells, and platelets. - Describe human respiration. - Trace filtration of waste substances from the blood by the nephron.

COLLEGE PREPARATORY BIOLOGY
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
A. Maintaining Life Systems (continued)	- Label structures and describe functions of the excretory system. - Identify bones of the skeletal system. - Describe functions of the skeletal system. - Describe function of the muscular system. - Describe how muscle cells work. - Identify origin and insertion of major muscles.
B. Controlling Life Systems	- Describe organs of the endocrine system and function of each. - Identify and describe three divisions of the nervous system. - Explain how a nerve impulse is transmitted. - Identify and describe effect of drugs and alcohol.
C. Reproduction and Development.	- Label and describe function of male and female reproductive organs. - Compare sperm cell with the egg cell. - Explain stages of the menstrual cycle. - Describe development of the human embryo. - Explain the birth process.

CHEMISTRY

Chemistry is the organized investigation of the properties, composition, and structure of matter; of the changes that occur in the matter; and of the energy involved in these changes.

A course in chemistry should promote student participation in the learning process by offering opportunities for students to use their senses to learn the basics of concrete concepts. Chemistry should also lead to the development of skills in analysis, synthesis, and evaluation. Primary emphasis should be placed on content and concepts and should be accomplished by involving students in a variety of activities.

Problem-solving is a fundamental part of any chemistry course. The difficulty level of the material should depend on the goals for the course and on the individual abilities of the students. Problems covered in the early part of the course are as important as those found in the latter part and therefore should be reviewed from time to time to reinforce problem-solving skills.

Laboratory work is an integral component of any science course and should be included both as a direct learning experience and as a motivational tool to increase student interest in classwork. Topics chosen for laboratory work should include environmental and household chemistry as well as topics related to classroom or textbook material.

Most students are aware of environmental problems such as air and water pollution and excessive energy consumption. These concerns, as well as those of developing technologies, should be discussed in chemistry classes from the point of view of gathering facts and developing possible solutions. Such discussions, along with laboratory experiences, make chemistry relevant for today's students.

CHEMISTRY

FIRST SEMESTER

SUGGESTED TIME FRAME		
1 week	I.	THE SCIENCE OF CHEMISTRY
		A. History of Chemistry
		B. Scientific Method
		C. Relationship to Other Subject Areas
		D. Laboratory Safety
2 weeks	II.	MEASURING AND COMPUTING
		A. The International System
		B. Base Units
		C. Mathematics 1. Significant digits 2. Scientific notation 3. Factor-label method of metric conversion 4. Accuracy and precision
2 weeks	III.	MATTER AND ENERGY
		A. Composition
		B. Properties of Matter
		C. Changes in Matter
		D. Forms of Matter
		E. Properties of Energy
		F. Forms of Energy
		G. Conservation of Matter and Energy
3 weeks	IV.	ATOMIC STRUCTURE
		A. Early Atomic Theory
		B. Models 1. Early models 2. Bohr model 3. Wave-mechanical model
		C. Quantum Theory

CHEMISTRY

FIRST SEMESTER

SUGGESTED TIME FRAME		
2 weeks	V.	THE PERIODIC LAW
		A. Historical Development
		B. Arrangement of the Periodic Table
		C. Predictive Value
4 weeks	VI.	CHEMICAL FORMULAS
		A. Symbols
		B. Valence or Oxidation Numbers
		C. Naming and Writing Compounds
		D. Molecular and Empirical Formulas
		E. Molecular Mass
		F. Avogadro's Number
		G. The Mole
4 weeks	VII.	CHEMICAL EQUATIONS
		A. Balancing Equations
		B. Classifying Chemical Changes
		C. Stoichiometry

CHEMISTRY

SECOND SEMESTER

SUGGESTED TIME FRAME	
3 weeks	VIII. CHEMICAL BONDING
	A. Ionization Energies
	B. Electron Affinities
	C. Electronegativity
	D. Ionic Bonding
	E. Covalent Bonding
4 weeks	IX. PHASES OF MATTER
	A. Solids
	B. Liquids
	C. Gases 1. Boyle's Law 2. Charles' Law 3. Combined Laws 4. Mass-Volume 5. Volume-Volume
6 weeks	X. SOLUTIONS
	A. Properties
	B. Process
	C. Concentration
	D. Ionization
	E. Equilibrium
	F. Acids
	G. Bases
	H. Salts

CHEMISTRY

SECOND SEMESTER

SUGGESTED TIME FRAME	
2 weeks	XI. CHEMICAL REACTIONS
	A. Chemical Energy
	B. Rates of Reaction
	C. Equilibrium
3 weeks	XII. OXIDATION-REDUCTION REACTIONS

264

CHEMISTRY
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
I. THE SCIENCE OF CHEMISTRY (1 week)	Students will:
A. History of Chemistry	- Identify names and state reasons for historical significance of famous chemists.
B. Scientific Method	- Solve problems in orderly ways.
C. Relationship to Other Subject Areas	- Express an understanding of the impact chemistry has on everyday life.
D. Laboratory Safety	- Establish and review laboratory safety rules and procedures.
II. MEASURING AND COMPUTING (2 weeks)	
A. The International System	- Use seven basic SI units.
B. Base Units	- Use standard and related measurements for length, time, temperature. - Use units in solving problems.
C. Mathematics	
1. Significant digits	- Determine the number of significant digits for given number of measurement.
2. Scientific notation	- Perform calculations using scientific notation.
3. Factor-label method of metric conversion	- Perform calculations using factor-label method of metric conversion and problem solving.
4. Accuracy and precision	- Differentiate between accuracy and precision.
III. MATTER AND ENERGY (2 weeks)	
A. Composition	- Distinguish between homogeneous, heterogeneous materials, elements, compounds, and mixtures.
B. Properties of Matter	- State examples of extensive and intensive properties.
C. Changes in Matter	- Distinguish between physical and chemical changes.
D. Forms of Matter	- Describe four phases of matter.

CHEMISTRY
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
E. Properties of Energy	- Differentiate between characteristics of endothermic and exothermic reactions.
F. Forms of Energy	- Relate forms of energy such as heat, light, electrical, etc., to particular types of chemical reactions.
G. Conservation of Matter and Energy	- Determine the heats of formation and reaction using enthalpy values and the law of conservation of energy.
IV. ATOMIC STRUCTURE (3 weeks)	
A. Early Atomic Theory	- Trace development of modern atomic theory through the years.
B. Models 1. Early models 2. Bohr model 3. Wave-mechanical model	- Trace development of various atomic models.
C. Quantum Theory	- Define four quantum numbers. - Explain effect of each of four quantum numbers on the electron cloud. - Write electron configuration and orbital notation for any atom.
V. THE PERIODIC LAW (2 weeks)	
A. Historical Development	- Explain basis for modern periodic law.
B. Arrangement of the Periodic Table	- Summarize arrangement of elements by similar electron configurations.
C. Predictive Value	- Predict the stability of elements. - Distinguish among metals, nonmetals, metalloids. - Predict sizes of atoms and ions. - Predict activity and oxidation numbers using position of the element on the periodic table.

CHEMISTRY
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
VI. CHEMICAL FORMULAS (4 weeks)	Students will:
A. Symbols	- Identify symbols of common elements.
B. Valence or Oxidation Numbers	- Give oxidation numbers of common elements.
C. Naming and Writing Compounds	- Write formulas for chemical compounds using oxidation numbers. - Name compounds from given chemical formulas.
D. Molecular and Empirical Formulas	- Differentiate between molecular and empirical formulas.
E. Molecular Mass	- Calculate molecular or formula mass for any substance.
F. Avogadro's Number	- State Avogadro's number and relate it to the mole.
G. The Mole	- Define the mole. - Compute the number of moles in a given mass. - Calculate the percentage composition of any given compound. - Determine the empirical formula of a substance from percentage composition data.
VII. CHEMICAL EQUATIONS (4 weeks)	
A. Balancing Equations	- State various parts of a chemical equation. - Give names or formulas for reactants and products. - Balance equations.
B. Classifying Chemical Changes	- Classify a reaction as one of four general types.
C. Stoichiometry	- Solve problems based on mass relationships in chemical reactions.

CHEMISTRY
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
VIII. CHEMICAL BONDING (3 weeks)	Students will:
A. Ionization Energies	- Explain ionization energy trends of the periodic table.
B. Electron Affinities	- Compare electron affinity to ionization energies. - Predict electron affinities and ionization energies based on electron configuration.
C. Electronegativity	- Use electronegativity to explain bond type.
D. Ionic Bonding	- Compare ionic and covalent bonds.
E. Covalent Bonding	- Compare properties of ionic and covalent compounds.
IX. PHASES OF MATTER (4 weeks)	
A. Solids	- Distinguish among seven crystal systems and identify examples of unit cells. - Distinguish among properties of metallic and nonmetallic crystals. - Describe examples of hygroscopic, deliquescent, efflorescent, and amorphous materials.
B. Liquids	- Relate LeChatelier's principle to temperature and pressure. - Explain relationship between energy and change of state. - Define melting point and boiling point in terms of vapor pressures.
C. Gases	
1. Boyle's Law	- Solve volume-pressure variation problems using Boyle's Law.
2. Charles' Law	- Solve temperature-pressure variation problems using Charles' Law.
3. Combined Laws	- Solve problems using ideal gas equation.
4. Mass-Volume 5. Volume-Volume	- Determine the mass or volume of reactants or products under standard or nonstandard conditions.

CHEMISTRY
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
X. SOLUTIONS (6 weeks)	Students will:
A. Properties	- State and give examples of nine physical state solution combinations.
B. Process	- Describe factors which affect the solution rate.
C. Concentration	- Solve problems involving molar and molal concentrations.
D. Ionization	- Write net ionic equations for reactions taking place in water.
E. Equilibrium	- Describe factors which influence rate of reaction. - Solve problems using an equilibrium constant.
F. Acids	- Compare Arrhenius, Bronsted-Lowry, and Lewis acid-base theories.
G. Bases	- Name and/or write formulas for common acids and bases. - Determine strengths of acids and/or bases.
H. Salts	- Give examples of common salts. - Identify neutralization reactions.
XI. CHEMICAL REACTIONS (2 weeks)	
A. Chemical Energy	- Distinguish between endothermic and exothermic reactions. - Determine heats of formation and reaction using enthalpy values.
B. Rates of Reaction	- Describe factors which affect rates of reaction.
C. Equilibrium	- Recognize an equilibrium situation and factors which would alter it. - Write the equilibrium constant expression from the equation for a reaction.

CHEMISTRY
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
C. Equilibrium (continued)	- Solve problems involving equilibrium constants.
XII. OXIDATION-REDUCTION REACTIONS (3 weeks)	- Assign oxidation numbers to elements in various compounds. - Balance oxidation reduction reactions.

PHYSICS

Physics is the science that deals with the properties and qualities of matter and its interrelationships. Physics is concerned with mechanics, heat, light, sound, electricity, magnetism, atomic and nuclear structure, radioactivity, and their applications to our world, lives, and environment.

The physics curriculum reflects current technology, trends, and concerns. A major objective is to present physics with a directness and simplicity that will provide maximum comprehension whether students take this one physics course or others to follow it.

Science in general and physics specifically must emphasize experiments, hands-on activities, practical applications, and individual research. Students should be encouraged to explore natural phenomena and pursue individual interests through science fairs, paper readings, olympiads, and other avenues of individual and group activities.

The curriculum is divided into two separate eighteen week semesters. The number of weeks suggested for each topic and the sequence of topics is presented to provide not only a systematic coverage and emphasis but to allow consistency across the State of Alabama.

PHYSICS

FIRST SEMESTER

SUGGESTED TIME FRAME		
1 week	I.	INTRODUCTION
		A. Growth of Physics
		B. Tools of Physics
		C. People of Physics
2 weeks	II.	MEASUREMENT
		A. Metric System
		B. Fundamental Units
		C. Derived Units
		D. Significant Figures
		E. Factor Method of Conversion
		F. Measuring Techniques
4 weeks	III.	FORCES
		A. Types
		B. Vectors
		C. Torque
6 weeks	IV.	MOTION
		A. Newton's Laws
		B. Linear
		C. Circular
		D. Graphical Analysis
		E. Momentum
		F. Collisions

PHYSICS

FIRST SEMESTER

SUGGESTED TIME FRAME		
6 weeks	IV.	MOTION (continued)
		G. Projectiles
		H. Harmonic
5 weeks	V.	ENERGY
		A. Types 1. Potential 2. Kinetic
		B. Work and Power
		C. Thermodynamics

PHYSICS

SECOND SEMESTER

SUGGESTED TIME FRAME	
2 weeks	VI. WAVES
	A. Characteristics
	B. Description and Properties
1 week	VII. SOUND
6 weeks	VIII. OPTICS
	A. Transmission Theories
	B. Description and Properties
	C. Reflection and Refraction
	D. Optical Devices
	1. Mirrors
	2. Lenses
	3. Lasers
1 week	IX. MAGNETISM
6 weeks	X. ELECTRICITY
	A. Electrostatics
	B. Superconductivity
	C. Currents
	1. Direct current
	2. Alternating current
	D. Circuits
2 weeks	XI. NUCLEAR PHYSICS
	A. Radioactivity
	B. Fission
	C. Fusion
	D. Environmental Concerns

PHYSICS
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
I. INTRODUCTION (1 week)	Students will:
A. Growth of Physics	- Summarize historical significance and development of physics. - Discuss significance of current technology. - Discuss socio-political advantages of technical ability.
B. Tools of Physics	- Use a variety of tools needed to do experimental work. - Establish and review laboratory safety rules and procedures.
C. People of Physics	- Identify personalities in physics.
II. MEASUREMENT (2 weeks)	
A. Metric System	- Use the metric system of units, estimate physical quantities in terms of these units, and solve simple problems.
B. Fundamental Units	- Use fundamental units of length, mass, and time in problem solving.
C. Derived Units	- Derive units for speed, density, acceleration, force, work, energy, etc., using fundamental units.
D. Significant Figures	- Solve problems using significant figures.
E. Factor Method of Conversion	- Solve problems of conversion within metric system.
F. Measuring Techniques	- Measure and record the physical quantities length, mass, and time. - Process data and determine average, absolute error, and percentage error.
III. FORCES (4 weeks)	
A. Types	- Identify forces acting on an object.

PHYSICS
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
A. Types (continued)	- Demonstrate or describe each type of force acting on an object, e.g. gravitational, frictional, inertial, centripetal, reaction, buoyant, elastic, electrical, and magnetic.
B. Vectors	- Represent a force with a vector. - Produce a resultant vector from the addition of two or more vectors. - Resolve a resultant vector into its components. - Solve graphically and analytically the resultant and equilibrant vectors.
C. Torque	- Determine individual or equilibrant forces needed to bring about equilibrium. - Demonstrate several different torque situations. - Determine component forces acting on an object on an inclined plane.
IV. MOTION (6 weeks)	
A. Newton's Laws	- State and cite evidence for the laws of inertia, acceleration, reaction, and gravitation. - Demonstrate using a variety of laboratory experiences - Newton's Laws of Motion.
B. Linear	- Solve problems and summarize relationships used to analyze uniform linear motion, e.g., velocity and acceleration. - Use data of an object's position at various times, correctly plot this data, and then use the plot to describe the object's motion. - Distinguish between displacement and position.

PHYSICS
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
B. Linear (continued)	- Use vectors to represent linear motion.
C. Circular	- Identify source of the central force for various physical situations and use relationships between the physical quantities involved to answer questions about the motion.
D. Graphical Analysis	- Interpret straight-line and distance-time graphs. - Interpret the slope of a line for both straight-line and changing motion graphs. - Explain meaning of the area under the curve. - Determine acceleration from a speed-time graph. - Recognize meaning of the curve when it is parabolic and find the slope of such a curve.
E. Momentum	- State law of conservation of momentum and apply law to solve problems. - Demonstrate relationship between the third law of motion and changes in momentum. - Distinguish between external and internal forces.
F. Collisions	- Solve problems involving inelastic collisions.
G. Projectiles	- Separate two dimensional motion into its components. - Use relationships developed for one-dimensional motion to analyze each component of the motion. - Combine components to describe the total motion of the projectile.
H. Harmonic	- Determine the force constant of a spring.

PHYSICS
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
H. Harmonic (continued)	- Analyze motion of an object that is exhibiting simple harmonic motion. - Plot graphs of position, speed, acceleration versus time for an object executing simple harmonic motion.
V. ENERGY (5 weeks)	
A. Types 1. Potential	- Define potential energy, how it is related to work, and determine the gravitational potential energy of an object.
2. Kinetic	- Define kinetic energy, how it is related to potential energy, and determine the kinetic energy of an object.
B. Work and Power	- Define how power is related to work, determine the necessary power for various physical situations. - State definition of work and use it to determine work done by various forces in different physical situations. - Use the definition of theoretical mechanical advantage, actual mechanical advantage, and efficiency for a simple machine, and determine these quantities for levers, various pulley systems, belt drives, geared systems, incline planes, wedges, screws, hydraulic systems, and combination of these simple machines. - Apply energy-related concepts to solve more difficult problems dealing with collisions, uniform circular motion, rotational motion, and harmonic motion.
C. Thermodynamics	- Distinguish between heat and temperature.

PHYSICS
FIRST SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
C. Thermodynamics (continued)	- Distinguish between internal and external energy. - Solve problems using Celsius and Kelvin temperature scales. - State the first law of thermodynamics. - State the second law of thermodynamics. - Solve problems using calories and joules. - Calculate heat exchanges and temperature changes related to heat transfer. - Calculate heat transfer through latent heat. - Read vaporization and fusion curves. - Interpret a triple-point diagram. - Solve problems using linear and volume coefficients of thermal expansion. - Experimentally determine coefficients of expansion. - Discuss practical applications of expansion, latent heat of fusion and vaporization.

PHYSICS
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
VI. WAVES (1 week)	Students will:
A. Characteristics	- Show relationship among speed, wavelength, frequency, and solve problems related to these. - Describe relationship between energy of a wave and its amplitude. - Describe source of various types of waves.
B. Description and Properties	- Describe how waves interact with matter and with other waves in the processes of reflection, refraction, diffraction, and superposition. - Describe Doppler effect and relate to practical everyday use for both sound and light.
VII. SOUND (1 week)	- Distinguish the following physical quantities: speed of propagation, frequency, pitch, wavelength, intensity, and loudness. - Explain how various musical instruments produce and vary sounds.
VIII. OPTICS (6 weeks)	
A. Transmission Theories	- State several different kinds of electromagnetic radiation and how they originate from various light sources. - Describe wave and particle theories of light. - Describe limitations of wave and particle theories in explaining various properties of light.
B. Description and Properties	- Define transparent, translucent and opaque. - Solve problems using basic units associated with luminous intensity, luminous flux, and illuminance.

280

PHYSICS
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
B. Description and Properties (continued)	- Summarize nature of color absorption and reflection. - Define diffraction. - Compare wave and particle models of light. - Draw an example of slit film interference and compare with interference in thin films. - Explain polarization of light and its useful applications. - Describe photoelectric effect and the quantum theory.
C. Reflection and Refraction	- State the law of reflection. - Predict paths of light rays through transparent objects. - Solve problems using Snell's Law. - Determine speed of light using the index of refraction. - Discuss total internal reflection and relate to useful applications such as fiber optics. - Describe some effects related to refraction such as mirage, spectrum, rainbow.
D. Optical Devices	
1. Mirrors	- Describe reflection in a plane mirror. - Distinguish between real and virtual images. - Draw six cases of reflection for curved mirrors. - Calculate location and size of images using the mirror equation.
2. Lenses	- Describe formation of an image using convex and concave lenses. - Using ray tracing techniques, diagram location and size of images for concave and convex lenses. - Define chromatic aberration. - Explain principle of operation of everyday optical devices.

PHYSICS
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
3. Lasers	- Describe the structure of the laser. - Research current trends in laser use.
IX. MAGNETISM (1 week)	- Detect presence of a magnetic field and determine its direction. - Determine type of a magnetic pole and how it will affect another pole. - Predict direction of fields and calculate their strengths for certain simple arrangements (Amperes Law). - Apply Lenz's Law to simple arrangements to determine direction of induced fields and currents. - Generate direct current electricity.
X. ELECTRICITY (6 weeks)	
A. Electrostatics	- State charge on a proton and electron. - Describe how objects may become electrically charged. - Describe behavior of an electroscope under different conditions. - Explain grounding. - Describe characteristics of conductors and insulators. - Solve problems using Coulomb's Law. - Describe an electric field model and state direction of the electric field. - Explain storage of electric charge, capacitance, and how to determine it. - Solve problems using formula for electric field intensity.
B. Superconductivity	- Define superconductivity. - Research current information on the development of superconductivity.
C. Currents	- Describe the flow of charges. - Define and use units such as volt, ampere, Coulomb, current, Ohm's Law, watt, electric field intensity, potential difference, and resistance.

PHYSICS
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
C. Currents (continued)	- Solve problems, using proper units, for power and Ohm's Law.
1. Direct Current	- Discuss sources of direct current. - Define electric current in terms of physical quantities. - Measure direct current using an ammeter. - Measure electrical resistance using an ohmmeter or Wheatstone Bridge. - Measure electrical potential difference with a voltmeter.
2. Alternating Current	- Discuss production of alternating currents. - Demonstrate production of AC using a magnet and coiled wire. - Measure current and potential difference and understand principle of operation of an AC ammeter and voltmeter. - Explain how AC/DC generators, motors, and meters work. - Discuss present-day use of AC and its advantages and/or disadvantages over DC.
D. Circuits	- Explain general aspects of an electric circuit. - Diagram simple electric circuits and locate meters correctly. - Relate voltage and resistance to control of current flow. - Explain relationship between electric and heat energy. - Solve problems using proper equations. - Discuss relationship between electric and heat energy and solve problems using proper equations. - Discuss methods of transferring electric energy over long distances with minimum loss. - Define kilowatt hour and solve problems to determine cost of energy used.

PHYSICS
SECOND SEMESTER

COURSE OUTLINE	INSTRUCTIONAL OBJECTIVES
	Students will:
C. Circuits (continued)	- Describe a series circuit, state how resistance is calculated, and solve problems with series circuits. - Describe a parallel circuit, state how resistance is calculated, and solve problems with parallel circuits. - Explore new concepts in electronics such as resistors, capacitors, transistors, printed circuits, and microcircuits.
XI. NUCLEAR PHYSICS (2 weeks)	
A. Radioactivity	- Discuss different types of radiation and their characteristics. - Discuss principles of detection of radioactive particles.
B. Fission	- Discuss meaning of nuclear fission and determine amount of energy available from a particular fission event.
C. Fusion	- Discuss meaning of nuclear fusion and determine amount of energy available from a particular fusion event.
D. Environmental Concerns	- Discuss principle of operation of a nuclear power plant. - Discuss environmental problems associated with nuclear power plants. - Discuss advantages and reasons for power plants.

ADDITIONAL COURSES

Additional courses in science should be developed to provide for student enrichment or acceleration. Such courses should be designed to meet the needs of varying student populations; therefore, no attempt will be made to list all possible courses in this document.*

Additional courses should supplement and not supplant the regular science curriculum. These courses, with exception of Advanced Placement courses listed in Appendix A, should be taken as electives in addition to other science courses and not instead of the regular courses. Carnegie Units of credit may be awarded the courses if they are constituted as regular classes and meet the time requirement in awarding such credit.

Two units of science, one life and one physical, are required for a standard diploma and three units of science, one life, one physical, and one that is either life or physical are required for an advanced diploma. It is recommended that no course be required, but instead the entire 9-12 science curriculum be considered an elective program. Specific grade levels are not attached to the courses; however, prerequisites may be advisable for some courses.

Courses included in this document are: Advanced Biology, Aerospace Science, Botany, Chemistry II, Ecology, Genetics, Human Anatomy and Physiology, Marine Science, Microbiology, Research and Design, and Zoology.

*If courses which are not included in this document are to be offered, permission must be granted by the State Board of Education.

ADVANCED BIOLOGY

Advanced Biology is a course for students who seek college preparation in science. Laboratory-oriented experiences, varying topics, and research in greater depth than in materials covered in a first-year biology course are requirements for this course. The curriculum should prepare students for upper-level college science and should include the following units.

I. Comparative Anatomy

II. Human Anatomy and Physiology

III. Bacteriology

IV. Botany

V. Entomology

VI. Embryology

VII. Ecology

VIII. Research in Selected Topics

IX. Oceanography

X. Marine Biology

XI. Medical Terminology

XII. Microbiology

AEROSPACE SCIENCE

Aerospace Science is a physical science course which communicates knowledge, skills, and attitudes about aerospace activities as well as the impact of space vehicles upon society.

The following topics should be included in the course.

I. History of Flight
   - A. Origins of Flight
   - B. Development of Flight Before 1900
   - C. Manned Flight to Present Day Flight

II. The Atmosphere

III. The Weather
   - A. Elements
   - B. Forecasting
   - C. Importance to Aerospace Travel

IV. Beyond Earth's Atmosphere

V. Elements of Flight
   - A. Basic Aeronautics (Theory of Flight)
   - B. Aircraft Propulsion
   - C. Aircraft Control
   - D. Aircraft Structures
   - E. Instruments
   - F. Navigation
   - G. Communications

AEROSPACE SCIENCE (continued)

VI. Aerospace Vehicles

- A. Types
- B. Uses

VII. Airports

VIII. Rocketry and Spacecraft

- A. Fundamental Laws and Operating Principles
- B. Propulsion Systems
- C. Guidance and Control
- D. Types and Uses

IX. Impact of Aerospace

- A. Economic Aspects
- B. Sociological Aspects
- C. Careers in Aerospace

BOTANY

Botany is a survey of plant diversity, including classification, morphology, physiology, and reproduction of plants. Extensive laboratory experiences are required. The course should include but not be limited to the following topics.

I. Plant Morphology and Physiology

II. Plant Taxonomy and Classification

III. Plant Reproduction

IV. Plant Ecology

V. Plant Evolution

VI. Domestic Plants

CHEMISTRY II

Chemistry II is an advanced course in chemistry which applies chemical concepts introduced and concepts not previously taught in first year chemistry. Laboratory activities which reinforce the scientific method and content of the course outline shown below should be stressed.

I. The Nature of Organic Compounds

II. Saturated Hydrocarbons

- A. Nomenclature
- B. Reactions
  1. Combustion
  2. Substitution

III. Unsaturated Hydrocarbons

- A. Nomenclature
- B. Reactions
  1. Hydrogenation
  2. Addition

IV. Aromatic Hydrocarbons

V. Alcohols, Phenols, and Ethers

- A. Nomenclature
- B. Reactions
  1. Oxidation
  2. Acids

VI. Organic Acids

- A. Nomenclature
- B. Esterification

VII. Amines

- A. Nomenclature
- B. Reactions

ECOLOGY

Ecology is a life science course which emphasizes the study of terrestrial and freshwater ecosystems, environmental issues, techniques of laboratory and field studies, and sources and control of pollution. It is recommended that this course be reserved for students desiring a fourth or fifth unit of credit in science. This course should include but not be limited to the topics listed below.

I. Biotic and Abiotic Factors

II. Energy Flow

III. Mineral Cycles

IV. Ecosystems

V. Biomes

VI. Native Flora and Fauna

VII. Effects of Pollution

- A. On Life
- B. On Weather and Climate

VIII. Environment and the Law

GENETICS

A genetics course should present topics on the elements of heredity from basic Mendelian concepts through molecular genetics and laboratory studies of inheritance in common organisms. It is recommended that this course be reserved for students desiring a fourth or fifth unit of credit in science. The course should include but not be limited to the topics listed below.

I. Principles of Heredity

II. Mendelian Genetics

III. Human Genetics

IV. Applied Genetics

V. Mutations

VI. Recombinant DNA

VII. Experimental Genetics

HUMAN ANATOMY AND PHYSIOLOGY

Human Anatomy and Physiology should prepare students for bio-medical, nursing, and other science-based careers. Laboratory dissections should include comparative anatomical studies including a mammal. The course should be organized so that it follows a logical sequence of the ten systems of the human body with emphasis on diseases and disorders. It is highly recommended that a unit of medical terminology be included.

I. Introduction

II. Skeletal

III. Muscular

IV. Digestive

V. Circulatory

VI. Respiratory

VII. Excretory

VIII. Nervous

IX. Endocrine

X. Reproductive

MARINE SCIENCE

Marine Science is an introductory course which encompasses physical composition, forces affecting, life forms, and future use and development of the marine environment. Appreciation for the sea and its contributions to all living things, an understanding of the importance of the sea to humankind and interrelationships among organisms, awareness of dangers to the sea, and the feasibility of increasing food supplies from the sea should also be addressed during the course.

Students should spend time in suitable outdoor environments collecting and classifying native marine flora and fauna. Analyses of water quality and observation of wildlife indigenous to the environment should also be a requirement. It is recommended that this course be reserved for students desiring a fourth or fifth unit of credit in science.

The following topics should be utilized in designing the curriculum for a course in Marine Science.

I. Physical and Chemical Dynamics of the Marine Environment

II. Forces Affecting the Marine Environment

III. Taxonomy of Marine Life Forms

IV. Future Uses and Development of the Marine Environment

MICROBIOLOGY

Microbiology is a life science course which presents the history, principles, cell structure and function, immunity, and diseases caused by microorganisms. Laboratory activities should be a major portion of the course and should include the topics listed in the outline given below. It is recommended that this course be reserved for students desiring a fourth or fifth unit of credit in science.

I. Culture

II. Identification of Bacteria

III. Classification of Bacteria

IV. Role in Nature of Microbiology

V. Medicinal Control of Bacteria

VI. Basic Skills in Microtechnique

RESEARCH AND DESIGN

Research and design offers students opportunities for independent study in science. The specific nature and content of the course should be determined by the individual needs and interests of the student. One or more research projects and papers should be required. Scientific method should be thoroughly examined, including topics such as controlling variables, statistical analysis, and scientific readings and abstracts. Competition in local and regional science fairs as well as paper readings also should be a requirement.

Prerequisites for this course should include permission of the science department chairperson, satisfactory completion of biology and either chemistry or physics. It is recommended that this course be reserved for students desiring a fourth or fifth unit of credit in science.

I. The Research Process

II. Planning a Research Project

III. Getting Assistance

IV. Data Analysis

V. Statistical Measures

VI. Instrumentation

VII. Protocol for Experimentation Involving Animals

VIII. Papers and Abstracts

IX. Safety

ZOOLOGY

Zoology presents a survey of animal diversity including classification, morphology, physiology, and reproduction in the animal kingdom. Laboratory activities are required for the course. The course should include but not be limited to the topics shown in the outline. It is recommended that this course be reserved for students desiring a fourth or fifth unit of credit in science.

I. Classification of Animals

II. Comparative Anatomy

III. Ecology

IV. Protection of Wildlife

V. Economic Importance of Wildlife

VI. Domestic Animals

APPENDIX A

ADVANCED PLACEMENT COURSES

ADVANCED PLACEMENT COURSES

Advanced Placement (AP) is a program of college-level courses and examinations for secondary school students. The program is sponsored and coordinated by The College Board and Educational Testing Service. The AP Program gives students opportunities to pursue college-level studies while still in high school and possibly to receive college credit upon entering a university or college of their choice. Presently, over 2,000 colleges and universities in the United States offer college credit to AP students who score at a specified level on the AP examinations.

A typical AP course is a special learning experience that takes a full academic year. The curriculum of the course is challenging and requires more effort and homework on the part of the student than a regular or honors high school course. It gives greater opportunity for individual progress and accomplishment and goes into greater depth with the academic material of each individual course. Course content and formal scholarship is the key objective toward which each student strives. A large portion of the educational value of the program is that students develop critical thinking skills, fluid writing abilities, problem-solving skills, and expertise in absorbing masses of material. While learning, students acquire self-discipline, self-confidence, and organizational skills. Furthermore, students are able to deal with strenuous traditional academic settings and ultimately to achieve at levels higher than they had previously thought possible.

ADVANCED PLACEMENT COURSE IN BIOLOGY

Presently, the AP Program offers a biology course which is designed to be the equivalent of a college introductory biology course usually taken by biology majors during their first year.

The AP biology course is designed to be taken by students after the successful completion of a first course in high school biology and high school chemistry. It aims to provide students with the conceptual framework, factual knowledge, and analytical skills necessary to deal critically with the rapidly changing science of biology. An AP Biology Committee has established goals for percentage coverage of three general areas: molecules and cells, 25 percent; genetics and evaluation, 25 percent; and organisms and populations, 50 percent. The percentage goals should serve as a guide for designing an AP biology course and may be used to apportion the time devoted to each category. The examination is constructed using the percentage goals as guidelines for questions' distribution.

Laboratory experiences are expected for AP biology students since the examination may contain questions directly related to laboratory exercises, and one-fourth of the credit in most college biology courses is derived from laboratory work.

Descriptive and experimental laboratory exercises should be assigned that will provide maximum opportunity for students to learn a variety of skills and concepts. One important purpose of the laboratory is to reinforce and expand those facts, principles, and concepts of general biology covered in lecture, reading, and discussion. Laboratory work should encourage the development of important skills such as detailed observation, accurate recording, experimental design, manual manipulation, data interpretation, statistical analysis, and operation of technical equipment.

ADVANCED PLACEMENT COURSE IN CHEMISTRY

Presently, the AP Program offers a chemistry course which is designed to be the equivalent of the general chemistry course usually taken during the first college year; and therefore, AP chemistry should meet the objectives of a good general chemistry course. Students in such a course should attain a depth of understanding of fundamentals and a reasonable competence in dealing with chemical problems.

The accumulation of specific facts of chemistry, begun in an elementary course, is continued in the AP course. Such facts are essential to enable students to comprehend the development of principles and concepts, to demonstrate applications of principle, to relate fact to theory and properties to structure, and to develop an understanding of systematic nomenclature which facilitates communication. The descriptive facts should not be isolated from the principles being studied and should be taught throughout the course to illustrate and illuminate the principles. The following areas should be covered:

1. chemical reactivity and products of chemical reactions;
2. relationships in the periodic table: horizontal, vertical, and diagonal;
3. chemistry of the main groups and transition elements, including examples of each; and
4. organic chemistry, including such topics as functional groups and isomerism (may be treated as a separate unit or as exemplary material in other areas such as bonding).

Laboratory experiences are expected for AP chemistry students as some of the questions on the AP Chemistry Examination are based on experiences and skills students acquire in the laboratory, such as making observations of chemical substances and reactions, recording data, and calculating and interpreting results based on the quantitative data obtained.

ADVANCED PLACEMENT COURSES IN PHYSICS

Presently, the AP Program offers two separate course descriptions in physics. Each is intended for qualified students who wish to complete studies in secondary school equivalent to college courses in these fields.

PHYSICS B

The Physics B course provides a systematic introduction to the main principles of physics and emphasizes the development of problem-solving ability. It is assumed that the student is familiar with algebra and trigonometry; calculus is seldom used, although some theoretical developments may use basic concepts of calculus. The B-level course provides a foundation in physics for students in the life sciences, premedicine, and some applied sciences, as well as other fields not directly related to science.

The Physics B Examination covers topics in mechanics, electricity and magnetism, kinetic theory and thermodynamics, waves and optics, and modern physics. A single examination grade is reported.

PHYSICS C

The Physics C course forms the first part of the college sequence that serves as the foundation in physics for students majoring in the physical sciences or engineering. The sequence is parallel to or preceded by mathematics courses that include calculus. Methods of calculus are used wherever appropriate in formulating physical principles and in applying them to physical problems. The sequence is more intensive and analytic than the Physics B course. Strong emphasis is placed on solving a variety of challenging problems, some requiring calculus. The subject matter of the C course consists primarily of mechanics and electricity and magnetism, with approximately equal emphasis on both areas.

The Physics C Examination corresponds to the Physics C course. One part of the Physics C Examination covers mechanics; the other part covers electricity and magnetism. Students are permitted to take either or both parts of this examination, and separate grades are reported for these two subject areas to provide greater flexibility in course planning and decision-making.

Course descriptions taken from material furnished by The College Board.

APPENDIX B

CAREER EDUCATION IN THE SCIENCE EDUCATION PROGRAM

INSTRUCTION IN ETHICS, MORAL VALUES, AND CITIZENSHIP IN SCIENCE

CAREER EDUCATION IN THE SCIENCE PROGRAM

Career education is a comprehensive educational approach to the preparation of students for living as fulfilled human beings in a predominantly technical, specialized society. Career education begins in kindergarten and continues throughout the student's school years.

The concept of developmental career education dictates the necessity for a total educational program which is relevant to the world of work and which is programmed to provide for

a. the development of an awareness of self and the world of work in elementary level students,

b. exploratory experiences for middle school students, and

c. the acquisition of knowledge and skills necessary for high school students to pursue further education or to become employed.

On February 2, 1984, the Alabama State Board of Education adopted Resolution F #40 which requires that the concept of career education be included in the curriculum of appropriate courses and subjects and that each local board of education ensure that career education be woven into the basic subject areas at grades K-12. Career education is intended to make education relevant and meaningful to students through the infusion of career education concepts in subject matter.

The purposes of career education are to

1. provide students with an understanding of their places and future in the world of work,

2. assist students in learning how to make decisions,

3. enable students to recognize and investigate career choice based on their own interests and aptitudes,

4. encourage students to have a positive attitude about the application of work, and

5. provide students with a clear understanding of the Free Enterprise System.

Science teachers should consider career education as an integral component of instruction to increase student ability to learn the content and skills included in this Course of Study. The science curriculum encompasses a wide range of technical skills and knowledge essential to the individual's successful participation in the world of work, and science teachers should utilize every possible opportunity to infuse career education activities into classroom instruction. Teaching science skills and knowledge in the context of career education will serve to enhance the relevancy of the curriculum for students.

The following represent some suggestions for teachers to utilize in integrating career education activities into science courses of instruction:

1. As students develop skills in analysis, synthesis, and evaluation, they can participate in career education activities that will relate these skills and competencies to learning about occupations and the world of work.

2. Students can research the educational, physical, and mental requirements for a career or occupation they are interested in investigating as a potential career. After the conclusion of their research about a specific career or occupation, they can write a theme or essay on how the career meets their needs as productive humans and citizens.

3. Career exploration is learning about career performance and associated lifestyles, rewards, leisure time, working conditions, and the education and training requirements needed to enter a specific occupation or career. As students learn science concepts, skills, and competencies, they should be able to utilize these for career exploration activities.

Research of this type has immediate practical value for students and society in a comprehensive, developmental program of career development that can extend throughout adulthood.

4. Decision-making skills are related to scientific skills such as distinguishing facts from opinion, researching sources of information, organizing and summarizing facts in order to reach tentative and final conclusions, and making recommendations. Through the application of these and other scientific concepts, skills, and competencies, students learn the value of making rational and sound career decisions.

Career education is not conceived to replace or be in addition to any educational programs in existence today. It is intended, however, to make educational subject matter more meaningful and relevant to the individual by integrating the world of experience and the world of work into the classroom. Career education concepts suggest that subject matter can be made more meaningful to students through reconstructing and refocusing subject matter concepts around a career development theme.

Infusing career education concepts into the Science Course of Study is based on the premise that education provides students with an understanding of how to live, how to learn, and how to earn. Career education is the education of today's students in a manner which will help them enhance their ability to live and succeed in the technological society of tomorrow. It prepares future adults to develop the philosophy that work has value and meaning to the individual and to society. It provides exposure to a wide variety of possible careers through examination of subject matter-related activities, so that young adults can make career choices on the basis of knowledge of their particular needs, abilities, interests, and the needs of society.

INSTRUCTION IN ETHICS, MORAL VALUES, AND CITIZENSHIP IN SCIENCE

The State Board of Education has a long history of affirming the inclusion of instruction in ethics, moral values, and citizenship in the courses of study utilized in the public schools of Alabama. In 1971, the Board approved a resolution setting up a plan for instruction in ethics and moral values in the school and reaffirmed this position in 1986 with a resolution mandating that the principles of citizenship, democracy, and patriotism be emphasized and taught in the classrooms of Alabama in each grade, K-12, in a planned, thorough, comprehensive, sequential, and verified way.

Schools in America have long served as important agents for the preservation and transmission of our culture. Education to engender beliefs and values has been a persistent theme in American education from the early colonial days to the present. Education in the home and school was designed to emphasize that individuals had to conduct themselves in ways consistent with a common set of beliefs that translated into moral guidelines for citizens.

Values consensus theory suggests that there is a set of core values in American society on which there is some measure of concurrence. The public clearly expects schools to inculcate those values for which there is consensus. The following is a list of concepts that embody many of the common values embraced by Americans:

A. To develop a positive self-concept based on the dignity of the individual, the acceptance of responsibility, honesty, wide decision-making skills, and courage and honor.

B. To respect others by showing kindness, demonstrating good sportsmanship, accepting those who are different, and exhibiting a sense of fair play and justice.

C. To plan for the world of work based on one's interests and abilities, an understanding of economics and the Free Enterprise System, and an appreciation for the dignity and value of work.

D. To become a good citizen by showing respect for public and private property and law and order, by participating in the democratic process, by learning about America's heritage, and by demonstrating patriotic behavior.

Instruction in ethical and moral values and in democratic beliefs permeates the curriculum in all areas and at all levels. Traditional American values are especially emphasized in the Social Studies Curriculum Guide and in the Guidance and Counseling State Plan for Excellence. Opportunities for emphasizing this instruction in science are also abundant. It is anticipated that science teachers will incorporate such instruction in their daily lessons at every opportunity. Any subsequent science instructional materials developed by the State Department of Education or by local education agencies should include comprehensive, documented instruction in ethical and moral development.

APPENDIX C

SCIENCE FOR SPECIAL EDUCATION STUDENTS

SCIENCE FOR SPECIAL EDUCATION STUDENTS

All students, regular and special, have a curiosity about their surroundings. Because of this natural interest in seeking information about the environment, teachers should capitalize on this by exposing all students to science.

It is appropriate to teach science to special education students because it actively involves students, is concrete, can be relevant and meaningful, and uses a wide array of natural and physical materials.

There are a number of additional benefits that these students gain by participating in science:

- Basic skills are applied in a meaningful context.
- First hand experiences help students to become familiar with their surroundings.
- These experiences give students a broad background to use when presented with new ideas, concepts, and information.
- Science provides students with opportunities to develop and to apply problem-solving skills.
- Skills needed for adult living and those useful for lifelong interests are acquired.

Because science will involve the acquisition of inquiry (doing and discovery) skills as well as knowledge (information), a variety of instructional strategies must be implemented in a science program for special education students.

Some teachers may select a textbook or textbook series while others may present teacher-developed units that capitalize on students' interests. Such decisions which are determined at the local level must ensure that lessons are sequential, structured, well-planned, and customized to meet the needs of each student.

General consideration to planning lessons include:

- deemphasizing reading
- involving students in doing--"hands-on"
- planning for safety
- relating lessons to the real world (career and life-skill topics)
- using strategies that involve the individual and also small groups
- eliciting discussion and encouraging students to ask questions
- ensuring that concepts and content are accurate
- presenting activities that are simple, brief, and programmed for success
- supplementing activities with microcomputer programs
- utilizing field trips

Special education students may receive science instruction in either a regular class or a special class. For those students who are capable of being mainstreamed successfully, their programs should include the same content as that provided to regular students. There may be some need for instructional modifications and/or accommodations in this environment. These decisions related to environment, along with decisions about curriculum content, should be determined by an Individualized Education Program (IEP) Committee. Any secondary grade level student who is pursuing a high school diploma must complete successfully those courses in science needed to fulfill both state and local requirements.

The outline below is for those students (Emotional Conflict, Learning Disabilities, and Educable Mentally Retarded) receiving instruction in special education classes. The outline is not a complete curriculum, but a framework on which teachers should build. Teachers may add other topics which capitalize on students' interests and may add new science-related topics that emerge during the year. The IEP Committee must make all decisions regarding the content of the science program for each special education student.

The following outline lends itself to flexibility yet is comprehensive enough to ensure a well-balanced program. Recommendations for science concepts are:

PRIMARY LEVEL (K-3)

- animals
- insects
- plants
- weather
- seasons
- wheels
- food
- water
- body parts
- important scientists

INTERMEDIATE LEVEL (4-6)

- plants
- animals
- human body
- senses
- ecology
- heavenly bodies
- food and nutrition
- energy and matter
- space
- air
- seasons
- important scientists

JUNIOR HIGH SCHOOL LEVEL (7-9)

- plants
- animals
- machines
- solar system
- ecology
- climate and weather
- water
- food and nutrition
- environment
- senses
- body systems
- energy
- important scientists

SENIOR HIGH SCHOOL LEVEL (10-12)

- functions and care of the human body
  - anatomy
  - disease and defense
  - care of the body
- plants
- animals
- ecology
- weather
- matter
- energy
- machines
- important scientists

At the primary and intermediate levels, instruction should include career awareness to familiarize students with different careers available in the scientific areas they have studied. The importance of work and work opportunities available in their communities should be stressed.

Junior high school students should have more "hands-on" activities that will enable them to explore different types of work associated with the scientific field. They should be given practical projects to work on, meet individuals who work in jobs related to science, and visit sites where scientific work or concepts are operationalized.

Career preparation for senior high school students interested in science-related occupations should be incorporated into the curriculum. Guidance, information, training, and work experiences should allow students to determine their individual interests and abilities and to plan for their future employment.

APPENDIX D

TIME REQUIREMENTS FOR SUBJECT AREAS

STUDY HABITS, HOMEWORK, AND STUDENT RESPONSIBILITIES

TIME REQUIREMENTS FOR SUBJECT AREAS

In accordance with # 1.1.5 (Action Item # F-1) adopted by the Alabama State Board of Education on February 23, 1984, which directs the State Courses of Study Committee to include time-on-task requirements in the State Courses of Study, the following recommendations are made:

THE TOTAL INSTRUCTIONAL TIME OF EACH SCHOOL DAY IN ALL SCHOOLS AND AT ALL GRADE LEVELS SHALL EQUAL 6 HOURS OR 360 MINUTES EXCLUSIVE OF LUNCH PERIODS, RECESS, OR TIME USED FOR CHANGING CLASSES.

THE FOLLOWING MINIMUM TIME ALLOTMENTS SHALL BE FOLLOWED:

SUBJECT AREA	GRADES 1-3	GRADES 4-6
Language Arts Spelling, Grammar, Listening, Handwriting Composition, Speaking	60 minutes daily	60 minutes daily
Reading	90 minutes daily	60 minutes daily
Mathematics	60 minutes daily	60 minutes daily
Science	30 minutes daily	45 minutes daily
Social Studies	30 minutes daily	45 minutes daily
Physical Education	30 minutes daily	30 minutes daily
Humane Treatment of Animals	20 minutes weekly	20 minutes weekly
Health	60 minutes weekly	60 minutes weekly
*Art	60 minutes weekly	60 minutes weekly
*Music	60 minutes weekly	60 minutes weekly
*Computer Literacy	60 minutes weekly	60 minutes weekly

*NOTE: The areas of Art and Music, as well as Computer Literacy, may be incorporated into other subject areas or taught separately on a rotating basis.

GRADES 7-12

A minimum of 140 clock hours of instruction is required for one Carnegie Unit of credit. A time allotment of either 50 minutes per day or 250 minutes per week will satisfy this requirement and still allow for flexible scheduling. This requirement applies to those schools which are not accredited as well.

In those schools where grade 7 and 8 are housed with other elementary grades, the school may follow the time requirements listed for grades 4-6 or the time requirements listed for grades 7-12.

REMEDIAL AND/OR ENRICHMENT ACTIVITIES

Remedial and/or enrichment activities should be a part of the time schedule for the specific subject area.

KINDERGARTEN

In accordance with Rule # 290-050-010-.02-.11ER Alabama Kindergarten, the overall daily time schedule of the kindergarten shall be the same as the schedule of the elementary schools in the system of which they are a part. In setting up a child's schedule, consideration should be given to rest periods and variety in activities. The schedule should provide some time for the child to follow individual interests in a relaxed, unhurried atmosphere. The schedule should be flexible and not followed in such a manner as to cause tension or a feeling of pressure on the part of the child. In a well-planned kindergarten program, a child should enjoy and profit from a full-day's activity.

STUDY HABITS, HOMEWORK, AND STUDENT RESPONSIBILITIES

Through classroom activities, students should learn to understand and to accept responsibility and to value the importance and dignity of work. Students need to become aware that their competency increases their ability to achieve desired goals and to function as responsible citizens. Early in school, students should learn that work and responsibility are important aspects of growing up. They should take pride in work well done.

It is important for students to see how their relationships with adults and classmates affect their performance and success in school. When students become responsible persons, they learn to accept and solve problems, as well as to trust in their own abilities. This acceptance of responsibility helps to make their relationships with others more meaningful and satisfying.

Guidelines for promoting appropriate student behaviors which lead to acceptance of responsibility should be developed by local boards of education. These guidelines should focus on giving students a sense of ownership or investment in their education. Lessons should include emphasis on student responsibility and evidence of student progress in accepting responsibility.

In relation to the understanding and acceptance of responsibility and to the value of the work ethic, students should learn to study effectively and to apply problem-solving and critical-thinking skills. Student responsibility in the learning process must be clearly defined. The use of study skills and homework should be a part of every student's instructional plan.